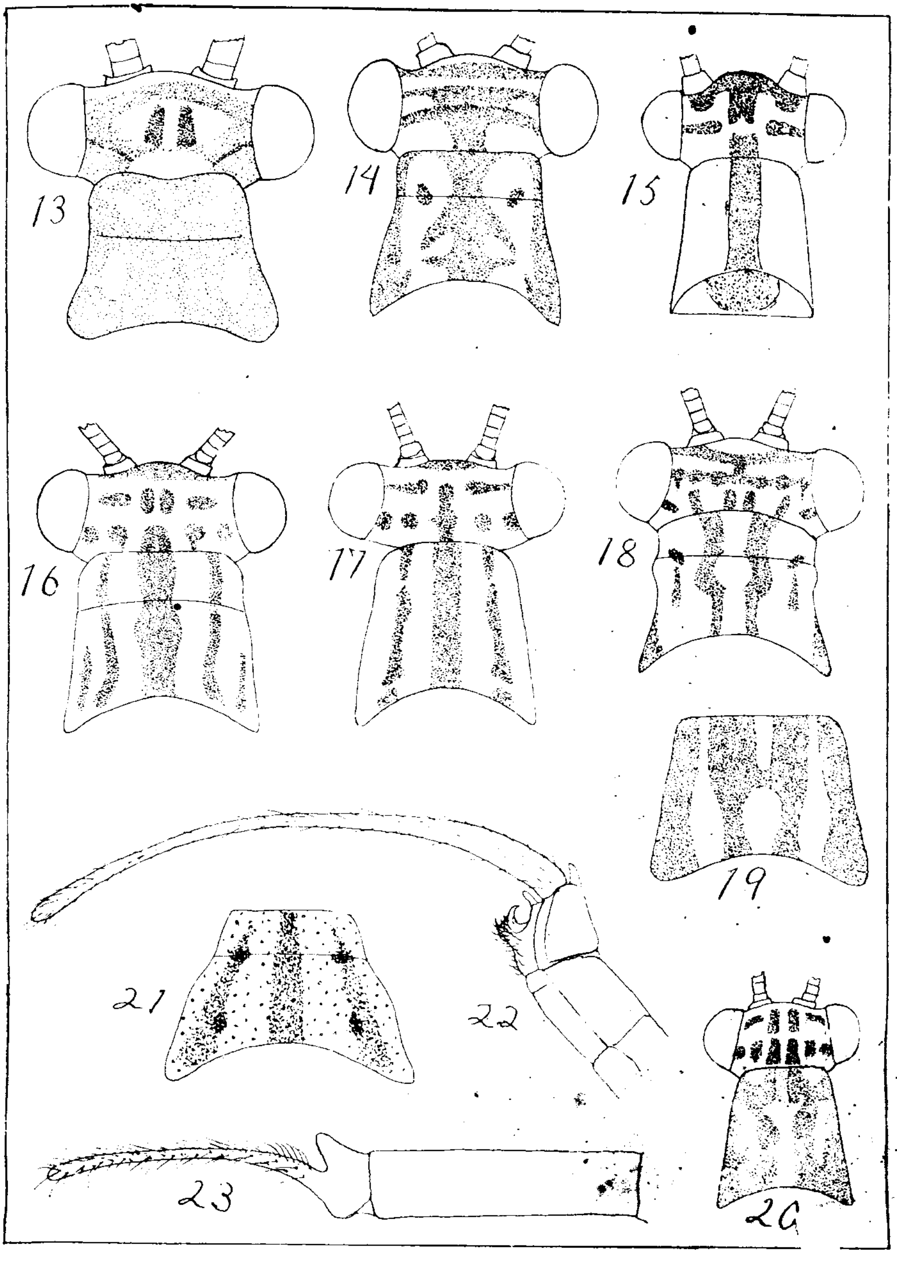

Nathan Banks.

THE LITHOBIOMORPHA OF THE SOUTHEASTERN STATES.

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In this paper is summarized our present knowledge of the genera and species of the Lithobiomorpha occurring in the extensive region lying south from Kentucky and the Virginias and east of the Mississippi river. The great majority of the records given are based upon collections made by the author himself in the summer of 1910, during which season all of the states in the territory indicated, excepting Florida, were visited. The southern portion of Georgia and the coastal region of this state and of the Carolinas were not covered. Some species additional to those here listed are likely to be found in these sections. The season was favorable for members of this group; and it is felt that the great majority of the more widespread forms were secured. In this connection it may be noted that in the case of most of the species specimens were taken in a considerable number of localities and that all the species previously recorded were again found excepting two from southern Georgia and Florida, where, as before mentioned, collections were not made.

Of especial interest are the genera Buethobius and Watobius, here erected for the first time, and Zygethobius, previously established by the author for a species occurring in the high mountain ranges of the western Unites States. The finding of a second species of Zygethobius in the mountainous section of this southeastern region fulfills what had been anticipated as likely. The three genera named are annectant and must alter to a considerable degree some prevalent conceptions as to affinities within the suborder. The genera recognized in the present paper may be separated as follows:

KEY TO GENERA.

a. Legs bearing bristles only, no articular spines present excepting sometimes one at distal end of tibia of all but last pairs of legs but this usually replaced by an acutely pointed process.
  b. First leg-bearing segment with a pair of spiracles.
    c. A single pair of ocelli; tarsi of first thirteen pairs of legs undivided, those of the last two pairs biarticulate....**Lamyctes** Meinert.
  bb. First leg-bearing segment without spiracles.
    c. Tarsi of first thirteen pairs of legs undivided, those of the last two pairs biarticulate; ocelli none. ....
Buethobius gen. nov.

cc. Tarsi of all legs biarticulate; ocelli present.
d. A single pair of ocelli present; an acutely pointed process at distal end of tibia; reproduction seemingly parthenogenetic, no males occurring....**Zygethobius** Chamberlin.
dd. A number of pairs of ocelli present, forming a patch on each side of the head; a spine at distal end of tibia; males occurring ....**Watobius** gen.nov.
aa. Legs provided with articular spines as well as with bristles; no acute process at distal end of tibia on cephalic side.
b. Coxal pores in a single series ....**Lithobius** Leach.
bb. Coxal pores scattered or in several series........**Bothropolys** Wood.

Genus **Lamyctes** Meinert.

1. **Lamyctes tivius** sp. nov.

Slender, widest at tenth dorsal plate, very gradually attenuated cephalad, more abruptly caudad.

Dorsum yellow to light brown, the head, prehensorial feet and ultimate segments darker; antennae and legs yellow.

Antennae of moderate length, composed of twenty-eight to thirty-one articles; first two articles long, the third and fourth very short, the fifth and sixth longer, the seventh and eighth again very short, the ninth longer, the tenth and eleventh in turn shorter, the twelfth and subsequent articles comparable to the ninth, or the thirteenth and fourteenth in some reduced; this alternation of pairs of shorter articles with longer ones in proximal portion of antennae apparently constant in this species.

A single pair of large ocelli.

Prosternal teeth 2+2, small, or 3+3, the outer one on each side smallest.

Angles of none of the dorsal plates produced.

Coxal pores small, round, 2, 3, 3, 3.

Anal legs long and slender, the joints of tarsus especially so; prefemur long, clearly more slender proximally than that of the penult pair, clavately enlarged distad; tibia of nearly uniform diameter throughout length, the first tarsal joint of similar shape and length but more slender. (See Pl. 3, fig. 2 cf. also figs. 1 and 3).

Claw of gonopods entire. Basal spines 2+2, rather stout, the inner considerably smaller.

Length 6-7.5 mm.

Localities.—Byram and Holly Springs, Miss.; New Orleans, La.; Jackson, Ala.; Atlanta, Ga.; Hot Springs, N. C.

2. **Lamyctes tivius** var. **pius,** var. nov.

Agreeing in general with the species as above described but conspicuously longer and more robust, the length of specimens examined lying between 9 and 9.5 mm. Color uniformly darker.

Locality.—Hot Springs, N. C.

Genus **Buethobius** gen. nov.

First leg-bearing segment without spiracles.

Ocelli none.

Tarsi of the first thirteen pairs of legs undivided, those of the fourteenth and fifteenth pairs biarticulate.

Legs without true spines. Tibiae of the first thirteen pairs of legs with an acutely pointed process at distal end on cephalic side like that of Lamyctes and Zygethobius. (See Pl. 4, fig. 1).

Apparently only females found and the reproduction parthenogenetic.

Type.—Buethobius oabitus sp. nov.

3. **Buethobius oabitus** sp. nov.

General color yellow or light yellowish brown; the head and prehensorial feet and in some the ultimate segments clear orange; antennae and legs clear yellow.

Rather slender, for most of length parallel sided. Narrowed over a few segments behind head and more abruptly at caudal end.

Antennae long, reaching the ninth body segment; composed of thirty-six articles of which those beyond the second are rather short, uniform.

Prosternal margin wide; teeth 3+3, very small.

Ocelli none.

Angles of none of the dorsal plates produced.

Coxal pores round, moderate in size; 3, 3, 3, 3—4, 4, 4, 4.

Legs of the first thirteen pairs each ending in three claws; those of the fourteenth and fifteenth pairs with the claws single. Anal legs long and slender.

Claws of gonopods undivided; basal spines 2+2.

Length 10-12 mm.; width at the tenth plate 1.3-1.4 mm.

Locality.—Byram and Canton, Miss.

Genus **Zygethobius** Chamberlin.

Sub-genus **Zantethobius** subgen. nov.

Angles of the sixth, seventh, ninth, eleventh and thirteenth dorsal plates produced.

Type.—Zygethobius pontis, sp. nov.

The previously described species, Z. dolichopus Chamb., the type of the genus, may be placed in a subgenus Zygethobius sens. str.

4. **Zygethobius pontis** sp. nov.

Moderately robust; strongly narrowed caudad and cephalad of the tenth dorsal plate, the first leg-bearing segment especially narrow.

Dorsum in color somewhat chestnut, with a narrow median longitudinal stripe blackish, the first segment darker than the others; head deep to blackish brown; prehensorial feet and antennae reddish, the

latter becoming paler, yellowish, distad; venter yellowish to light brown, the caudal plates reddish; legs brown, paler proximally than distally; last pairs of legs darker, blackish proximally, pale distad.

Antennae very long; composed of forty-three articles which are short.

The ocelli of the single pair very large.

Prosternal teeth 3+3.

Angles of the sixth, seventh, ninth, eleventh and thirteenth dorsal plates produced.

Coxal pores 3, 4, 4, 4.

The process at distal end of anterior pairs of legs apically acutely spinescent. (See Pl. 4, fig. 2).

Anal legs long and slender.

Claw of gonopods entire; basal spines 2+2.

Length ad 10.5 mm.; width of tenth plate 1.6 mm.

Localities.—Johnson City, Tenn.; Natural Bridge, Va.

Genus **Watobius** gen. nov.

First leg-bearing segment without spiracles.

A number of pairs of ocelli present, these forming a patch on each side of the head as in Lithobius, a caudal one in the place of the so-called single ocellus in the latter genus and the others toward the base of the antenna.

Tarsi of all legs biarticulate.

Legs without true spines excepting one at distal end of tibia of anterior legs in place occupied by the process in the preceding genera.

Fifth joint in penult legs of male greatly enlarged, the anal (in type) not modified.

Both sexes occurring.

Type.—Watobius anderisus sp. nov.

5. **Watobius anderisus** sp. nov.

Slender, attenuated from the tenth dorsal plate cephalad, more abruptly caudad.

Brown, the ultimate segments often darker; head and prehensorial feet conspicuously darker, deep brown or brownish black; antennae brown, pale distad; legs light brown, the posterior pairs having a purplish tinge, the anal and penult pairs abruptly pale distad of the femur, the tibiae in the penult legs especially pale.

Angles of the ninth, eleventh and thirteenth dorsal plates produced.

Antennae short; in most composed of twenty-two articles, in some of but twenty; articles decreasing in length gradually and uniformly from the first to the penult.

Ocelli on each side composed of one large posterior one, in place of the single one in Zygethobius, etc., and of eight smaller ones in a patch arranged in three series; thus, 1+3, 3, 2.

Prosternal teeth 2+2.

Angles of the ninth, eleventh and thirteenth dorsal plates produced.

Coxal pores small, 2, 2, 2, 2.

All legs with three claws excepting those of the ultimate pair which seem to have the exterior accessory claw but to lack the inner one.

Anal legs of male moderately and uniformly crassate; the penult legs with the fifth joint strongly enlarged and somewhat flattened dorso-ventrally, complanate above or weakly depressed, complanate and weakly furrowed beneath. (See Pl. 3, figs. 4 and 5).

Claw of female gonopods tripartite; basal spines 2+2.

Length 7.5-9.5 mm.

Localities.—Thomasville and Anniston, Ala.; Tallulah Falls and Bremen, Ga.

Genus **Lithobius** Leach.

Several of the species listed under this genus below conform to Monotarsobius as defined by Verhoeff in having the anterior tarsi (those of the first thirteen pairs of legs) undivided whereas those of species belonging to Lithobius proper have the tarsi all biarticulate. However, this character seems variable to such an extent that it is difficult to place some species upon this basis; hence, it seems best not to maintain it until some correlated characters, if such exist, shall be worked out. Those species which have the anterior tarsi clearly undivided are specially indicated below.

6. **Lithobius coecus** Bollman.

1888. Lithobius coecus, Bollman, Ann. N. Y. Acad. Sci., p. 111.

Locality.—Saluda, N. C. The only other known locality for this species is that at which the types were collected, Beaver Creek, Tenn.

7. **Lithobius tuobukus** sp. nov.

Light brown to yellow, the posterior segments often darker; head concolorous with body or often a darker, reddish brown; antennae light brown proximally, paler distad; legs light brown, the posterior pairs yellow, especially bright distad.

Antennae short or moderate; articles 25-29, all except the first few moderate or short in length.

Prosternal teeth mostly 5+5 or 6+6, small, even.

Ocelli compactly arranged in an oblong patch in three series; thus 1+4, 5, 4, a total of 14.

None of the dorsal plates with the posterior angles produced.

Coxal pores rather small, round, 3, 4, 4, 3.

Last two pairs of coxae armed laterally, the last four pairs dorsally.

Spines of the first legs 2, 2, 1; of penult 1, 3, 3, 2, the claw single; of the anal 1, 3, 3, 2, the claw also single.

In the male the anal legs are moderately crassate, especially the third and fourth joints; the fourth joint is flattened or somewhat excavated dorso-mesally and is often produced at distal end into a lobe extending mesad and bearing at its apex a spine directed caudad, but in many this lobe is absent. (See Pl. 3, fig. 7).

Claw of the gonopods in female entire; spines 2+2.

Length 9.5–12 mm.

Localities. Brown's Summit, N. C.; Natural Bridge, Chatham, and Lynchburg, Va.; White Suplhur, W. Va.; Hot Springs, Linville Falls, Asheville, N. C.; Greenville, S. C.; Russellville, Johnson City and Unaka Springs, Tenn.; Lexington, Ky.

Very close to species 12 but the penult legs with only one claw instead of with three. Mr. Bollman mentions no modification in the anal legs of the male of L. proridens nor does the specimen listed below under this species present such. The only course open at present, therefore, seems to be to separate the present species from proridens and possibly to assume, judging from localities given for proridens, that Bollman has included the two species under one name.

8. **Lithobius watovius** sp. nov.

General color yellow; head, prehensorial feet and posterior segments darker, orange; antennae and legs yellow.

Antennae short, composed of twenty articles which, excepting the first two and the ultimate, are moderately short.

Prosternal teeth 2+2 or 3+3, the outer tooth on each side weak or obsolete.

Ocelli about four, arranged in one or two series; thus 1+2, 1.

Angles of none of the dorsal plates produced.

Tarsi of the first thirteen pairs of legs undivided, those of the last two pairs biarticulate as usual (Monotarsobius).

Coxal pores 1 (2), 2, 2, 2.

Ultimate pair of coxae laterally armed, the last three pairs dorsally armed.

Spines of the first legs 0, 2, 1-1, 2, 1, (2); of penult 1, 3, 3, 0, without supplementary claw; of anal 1, 3, 1, 0, also without supplementary claw.

Anal and penult legs in the male uniformly crassate.

Length 6.7 mm. (larger specimen).

Locality.—Byram, Miss. Two males were taken.

9. **Lithobius paitius** sp. nov.

Dorsum pale brown; head and posterior segments darker, dark orange; legs greyish, except the caudal pairs which are bright yellow, with the brush of hairs on anal legs of male red proximally and yellow distad; antennae grey to dull yellow; venter pale grey to greyish yellow.

Antennae short, consisting mostly of twenty-four articles which are short excepting the first two and the ultimate.

Ocelli small, in a small patch; in number about seven, arranged thus, 1+3, 3.

Prosternal teeth 2+2.

Angles of none of the dorsal plates produced.

Coxal pores 2, 4, 4, 3, small.

Last pair of coxae laterally armed, last two pairs dorsally armed.

Tarsi of the first thirteen pairs of legs undivided (Monotatsobius).

Spines of the first legs 0, 1, 1; of the penult 1, 3, 2, 1, without supplementary claw; of anal 1, 3, 2, 0, also without supplementary claw.

In the anal legs of the male the fourth joint is strongly swollen and provided at proximal end with a lobe on dorso-mesal surface from the posterior surface of which springs a dense brush of very long hairs which projects beyond the caudal end of the joint. (See Pl. 3, fig. 6).

In the female the claw of the gonopods is bluntly tripartite, the lateral lobes being not much lower than the middle one; basal spines as usual, 2+2.

Length 6.5–7 mm.

Locality.—Catawba, N. C.; Unaka Springs, Tenn.

10. **Lithobius watsuitus** sp. nov.

Dorsum light brown; head much darker, reddish brown or chestnut; prosternum colored like head, but its feet pale distad; antennae dark brown, paler distad; venter with the anterior plates commonly with purplish tinge; most legs light yellowish brown, but the caudal pairs darker, brown, excepting tarsi which are light.

Antennae short; composed of thirty to thirty-two articles which, beyond the third are short and compactly united.

Ocelli about eight, arranged in two series; thus 1+4, 3.

Prosternal teeth, 2+2.

Angles of none of the dorsal plates produced.

Coxal pores small and round, 2, 3, 3, 3–3, 3, 3, 3.

Ultimate coxae laterally as well as dorsally armed.

Spines of the first legs 1, 2, 1; of penult 1, 3, 3, 1, one supplementary claw present; of anal 1, 3, 2, 0, the claw single.

Anal and penult legs in the male crassate, especially so the fourth joint which is somewhat flattened dorso-ventrally and is longitudinally weakly furrowed.

Length 7.5–9 mm.

Localities.—Atlanta, Ga.; Natural Bridge, Va. The specimen from Virginia differs in having the spines of the anal legs 1, 3, 2, 1, instead of 1, 3, 2, 0.

11. **Lithobius bilabiatus** Wood.

1867. Lithobius bilabiatus, Wood, Proc. Phil. Acad. Sci., p. 130.
1887. Lithobius tuber, Bollman, Proc. U. S. N. M., p. 256.

Localities.—Canton and Byram, Miss. This species is found in the states along the Mississippi river from the Gulf to Wisconsin and Minnesota. It seems to be most abundant in Illinois and Iowa.

12. **Lithobius proridens** Bollman.

1887. Lithobius proridens, Bollman, American Naturalist, p. 81.
1887. Lithobius proridens, Bollman, Proc. U. S. N. M., p. 258.

Locality.—Watervalley, Miss. One male agreeing fully with the original description. Previously reported from Indiana (type locality), Washington, D. C.; Arkansas, and Tennessee (Knoxville, Mossy Creek).

13. **Lithobius branneri** Bollman.

1888. Lithobius branneri, Bollman, Ann. N. Y. Acad. Sci., p. 107.
1888. Lithobius branneri, Bollman, Proc. U. S. N. M., p. 111, 112, 342.

Localities.—Brookhaven, Miss. (var. a); Maplesville, Ala.; Atlanta, Ga. (var. b); Catawba and Brown's Summit, N. C.; Asheville, N. C. (var. c); Russellville and Unaka Springs, Tenn. (author). Also Knoxville, Beaver Creek, and Mossy Creek, Tenn. (J. C. and C. B. Branner, seq. Bollman).

Several closely related varieties are represented in the material here referred to this species. The incompleteness of the original description must make it doubtful which variety is typical until the types are re-studied. The species has the anterior tarsi undivided (Monotarsobius).

14. **Lithobius lundii** Meinert.

1886. Lithobius lundii, Meinert, Myr. Mus. Haun., III, p. 111.
1887. Lithobius lundii, Bollman, Proc. U. S. N. M., p. 111.

Localities.—Lula and Tallulah Falls, Ga.; Taylor's, S. C.; Asheville and Hot Springs, N. C.; Johnson City and Unaka Springs (and also Beaver and Mossy Creeks, seq. Bollman), Tenn.; Natural Bridge, Va.

This species, originally described from New York State, ranges into the southern states along the uplands.

15. **Lithobius exiguus** Meinert, var.

1886. Lithobius exiguus, Meinert, Myr. Mus. Haun, III, p. 110 (11).
1911. Lithobius exiguus, Chamberlin, Canad. Ent.

Localities.—Longbeach, Brookhaven, Canton, Jackson, and Holly Springs, Miss.; Selma (var. b), Thomasville, Morgan. and Birmingham, Ala.; Jackson, Tenn.; Lexington, Ky.; Lynchburg, Va.

A widespread species occurring commonly under leaves and sticks and among stones along streams in Wisconsin, Illinois, Iowa, and neighboring states as well as throughout the region covered in the present paper.

16. **Lithobius elattus** Bollman.

1888. Lithobius elattus, Bollman, Proc. U. S. N. M., XI, p. 348.

Localities.—Johnson City and Russellville, Tenn.; Chatham, Lynchburg, Natural Bridge, and Balcony Falls, Va. (also Marksville, Va., and Washington, D. C., seq. Bollman); White Sulphur, W. Va.

The specimens listed here differ somewhat from those described by Bollman in one or two particulars but probably represent the same species.

17. **Lithobius aureus** McNeil.

1887. Lithobius aureus, McNeil, Proc. U. S. N. M., p. 327.

Locality.—Pensacola, Fla. (seq. McNeil). The two specimens upon which this species was based lack the anal legs. As a result it is difficult to identify the species from the published description.

18. **Lithobius pinguis** Bollman.

1888. Lithobius pinguis, Bollman, Entom. Americana, IV, p. 7.

Localities.—Hudsonville, Miss.; (Little Rock, Ark., the type locality, seq. Bollman).

Because of the incompleteness of the original description and the fewness of the specimens upon which based the reference of the specimens in hand to this species is provisional. It is possible that the following species may have to be merged with the present one; but in view of the important differences between the specimens of L. euthus and Mr. Bollman's description, this union at present seems impossible.

19. **Lithobius euthus** Chamberlin.

1904. Lithobius euthus, Chamberlin, Proc. Acad. Sci. Phil., p. 652.

Localities.—Byram, Canton, and Gulfport, Miss.

20. **Lithobius cantabrigensis** Meinert.

1885. Lithobius cantabrigensis, Meinert, Proc. Amer. Phil. Soc., XXI, p. 177.
1888. Lithobius cantabrigensis, Bollman, Proc., U. S. N. M., XI, p. 342.

Localities.—Greenville, S. C.; Saluda, N. C.; Balcony Falls, Va.; Russellville, Tenn.; (also Beaver and Mossy Creeks, Tenn., seq. Bollman).

Described originally from Mass., the only other recorded locality.

The species seems to have a strong tendency toward the formation of local varieties.

21. **Lithobius cantabrigensis** var. **suitus,** var. nov.

Dorsum brown; the head and posterior segments darker, reddish; antennae pale distally; legs pale brown, the posterior pairs darker but with their distal joints distinctly lighter.

Antennae moderate, composed of from twenty-nine to thirty-two articles.

Ocelli about eight or nine arranged in two or three series; thus, 1+4, 4, or 1+3, 3, 1.

Prosternal teeth 2+2.

Angles of the eleventh and thirteenth dorsal plates produced or these in some nearly straight.

Coxal pores round, 3, 4, 4, 3.

Posterior coxae unarmed.

Spines of the first legs 0, 0, 1–0, 1, 1; of the penult 1, 3, 2, 1–1, 3, 3, 1, with two claws; of the anal, 1, 3, 2, 0, with two claws.

Gonopods in the female with the claw tripartite or almost bipartite in some through reduction of one lateral lobe.

Length 7–9 mm.

Localities.—Hot Springs, N. C.; Birmingham, Ala.

The anterior tarsi in part seem consolidated or undivided, but the form scarcely would conform to Monotarsobius.

22. **Lithobius cantabrigensis** var. **zinus** var. nov.

Color brown; head and posterior segments darker, not reddish; antennae dark, paler distally.

Antennae composed mostly of from twenty-eight to thirty-one articles, more rarely thirty five or even thirty-seven.

Ocelli eleven to sixteen, arranged in three or four series; thus, 1+4, 4, 4, 3-1+3, 4, 3.

Ultimate coxae laterally armed.

Spines of the first legs 1, 1, 1–1, 2, 1; of penult legs, 1, 3, 3, 1–1, 3, 3, 2, with two claws; of the anal legs 1, 3, 2, 0–1, 3, 2, 1, likewise with two claws.

In the male the anal and penult legs moderately crassate, the fourth joint in the anal ones larger and somewhat complanate dorsally.

Length 8-10 mm.

Localities.—Talapoosa and Bremen, Ga.; Anniston, Ala. (variant); Brown's Summit, N. C.; Chatham, Natural Bridge, and Lynchburg, Va.

24. **Lithobius atkinsoni** Bollman.

1887. Lithobius atkinsoni, Bollman, Proc. U. S. N. M., X. p. 625.
1888. Lithobius atkinsoni, Bollman, Proc. U. S. N. M., XI, p. 349.

Bremen, Atlanta, Lula, and Tallulah Falls, (also Macon, seq. Bollman), Ga.; Taylor's, Greenville and Seneca, S. C.; Saluda and Hot Springs (also Balsam seq. Bollman), N. C.

The localities here indicated are all those thus far recorded for this species.

24. **Lithobius naiwatus** sp. nov.

Brown; the head and posterior segments darker; antennae pale distad; legs yellowish to whitish brown; the anal and sometimes also the penult legs dark purplish brown or purplish black, with the distal joints pale.

Antennae of moderate length or short; composed of thirty-two to thirty-five articles of which most of the first ten are of medium length and those more distad short.

Ocelli about thirteen, compactly arranged in three straight series; thus, 1+5, 4, 3.

Prosternal teeth 2+2.

Posterior angles of the ninth, eleventh and thirteenth dorsal plates produced.

Coxal pores small, round, 4, 5, 5, 4.

Last two pairs of coxae armed laterally, last three pairs armed dorsally.

Spines of first legs, 1, 2, 1-2, 2, 1; of the penult legs 1, 3, 2, 1-1, 3, 2, 0 with two claws; of the anal legs 1, 3, 3, 2, with a single claw.

Anal and penult legs in male moderately crassate, without special lobes or processes.

Claw of the gonopods in the female tripartite; basal spines 2+2 conical, the inner smaller.

Length 11-13 mm.

Localities.—Saluda, Catawba, and Linnville Falls, N. C. Landrum, S. C.; Tallulah Falls, Ga.; Unaka Springs, Tenn. Lexington, Ky. (var.)

25. **Lithobius forficatus** (Linneus).

1758. Scolopendra forficata, Linneaus, Syst. Nat., I, p. 638.
1815. Lithobius forficatus, Leach, Tr. Linn. Soc., XI.
1821. nec Lithobius spinipes Say, Journ. Acad. Sci. Phil., II, p. 108.
1845. Lithobius americanus, Newport, Tr. Linn. Soc., XIX, p. 365.

Localities.—Greenville, S. C.; Asheville and Hot Springs, N. C.; Lynchburg and Balcony Falls, Va.; White Sulphur, W. Va.; Fulton and Lexington, Ky.

The range of this species, so abundant in the north, is carried southward into our present territory by the mountain ranges. It has not previously been reported from the Carolinas or other points so far south in this district.

26. **Lithobius celer** Bollman.

1888. Lithobius celer, Bollman, Entom. Amer., IV, p. 7.
1909. nec. Lithobius celer, Chamberlin, Ann. Ent. Soc. America, p. 190.

Locality.—Fulton, Ky.

27. **Lithobius oedipes** Bollman.

1888. Lithobius oedipes, Bollman, Entom. Amer., IV, p. 8.

Locality.—Mississippi.

28. **Lithobius manegitus** sp. nov.

Dorsum dark brown; head darker, nearly mahogany, the antennae similar proximally but becoming paler or rufous distad legs brown above, mostly paler ventrally, and the posterior pairs mostly pale distad.

Antennae moderate; composed of twenty articles which decrease in length from the second distad to the penultimate.

Ocelli in a patch situated apparently closer than usual to the base of antenna; in number about nine, arranged in three series; thus 1+3, 3, 2.

Prosternal teeth 2+2; a characteristic stout spine uniformly present on each side ectad of the outer tooth.

Angles of the ninth, eleventh and thirteenth dorsal plates produced.

Coxal pores round, in number 5, 5, 5, 4.

Last two pairs of coxae armed laterally; only the ultimate coxae armed dorsally.

Spines of the first legs 1, 2, 1-2, 2, 1; of the penult 1, 3, 3, 2, with two claws; of the anal 1, 3, 3, 1, provided also with two claws.

In the male the anal legs are crassate and the tibia or fifth joint is conspicuously furrowed lengthwise dorsally toward the exterior side, the furrow being fringed on each side by a dense growth of hair, the hair longest at posterior end (See Pl. 4, fig. 7). The penult legs more crassate than the anal, the fourth and fifth joints most enlarged; the fifth joint or tibia furrowed from end to end along the meso-ventral surface and excavated on this surface at the distal end where there is a process bearing a conspicuous brush of hairs which projects mesad (See Pl. 4, figs. 4, 5 and 6.)

The gonopods of female with the claw entire; basal spines 2+2, conical, the inner the smaller.

Length 15-17 mm.

Localities.—Hot Springs, Catawba, Saluda and Linville Falls, N. C.; Johnson City, Unaka Springs and Altapass, Tenn.

Very close to L. oedipes Boll., but differing markedly in characters of the anal and penult legs of the male.

29. **Lithobius tabius** sp. nov.

Brown; head and commonly also the first dorsal plate darker, chestnut; antennae dark, pale distad; legs a much paler brown, the posterior pairs darker with the distal joints pale.

Antennae short; composed of about thirty-three articles.

Ocelli sixteen, arranged in four series; thus, 1+4, 4, 4, 3.

Prosternal teeth 2+2.

Angles of the ninth, eleventh and thirteenth dorsal plates produced, those of the sixth and seventh excised or obliquely truncate.

Coxal pores round, 4, 4, 4, 3.

Last two pairs of coxae laterally armed, last four pairs armed dorsally.

Spines of first legs 1, 2, 1; of the penult 1, 3, 2, 1, with two claws; of the anal 1, 3, 3, 2, with two claws.

Claws of the gonopods in female tripartite.

Length 10.5 mm.; width at tenth dorsal plate 1.5 mm.

Locality.—Johnson City, Tenn.

In many points very similar to arienus, carolinae, etc., but the angles of the sixth and seventh dorsal plates not at all produced.

30. **Lithobius simitus** sp. nov.

Brown; the head and posterior plates reddish, the former paler cephalad of the frontal suture; antennae dark brown, pale distally; legs whitish brown, the tarsi clear yellow, the posterior pairs darker, the anal pair yellow distad of the femur; venter light brown, darker caudad, the anterior plates with purplish tinge.

Antennae short, composed of twenty-seven to thirty-two short articles.

Ocelli arranged in two series, about eight in number; thus, 1+4, 3.

Prosternal teeth 2+2.

Angles of the ninth, eleventh and thirteenth dorsal plates produced.

Coxal pores small, 2, 3, 3, 3.

Last two pairs of coxae armed laterally, last three pairs armed dorsally.

Tarsi of the first thirteen pairs of legs imperfectly divided in part but suture mostly plainly evident.

Spines of the first legs 0, 0, 0-0, 0, 1; of the penult 1, 3, 2, 0, with two claws; of the anal 1, 3, 2, 0, a supplementary claw likewise present.

Claw of the female gonopods bipartite; basal spines 2+2, conical.

Length 7–7.5 mm.

Locality.—Grenada, Miss. Two female specimens.

1. **Lithobius transmarinus** Koch.

1862. Lithobius transmarinus, Koch, Die Myriopodengattung Lithobius, p. 31.
——. Lithobius mordax, Koch, ibid. p. 31.
1872. Lithobius mordax, Meinert, Myr. Mus. Haun., II p. 294.
1875. Lithobius transmarinus, Stuxberg, Öfvers. af K. Vet. Akad. Forh. no. 3, pp. 26 and 32.
——. Lithobius mordax, Stuxberg, ibid., pp. 27 and 32.
1887. Lithobius mordax, Bollman, Proc. U. S. N. M., p. 263, etc.
——. Lithobius transmarinus, Bollman, ibid., p. 626, etc.
1893. Lithobius spinipes, Bollman, (of Say??), Bull. U. S. N. M., 46, p. 146.
1896. Lithobius mordax var. Louisianae, Brölemann, Ann. Soc. Ent. de France, p. 48.
——. Lithobius transmarinus var. permatus, Brölemann, ibid., p. 48.

Localities.—Brookhaven, Fernwood, Holly Springs, Byram, Canton, Biloxi, Ocean Springs, and Longbeach, Miss.; New Orleans, La.; Jackson, Mobile, and Salem, Ala.

Apparently Koch based his description of transmarinus upon a female while his description of mordax is clearly that of the male. The differences pointed out between the anal legs of these two forms are essentially secondary sexual characters as found in male and female of the present species, although the longitudinal furrows on the mesal surface of the sixth and seventh joints in the female vary in development and may be deeply impressed in some, in others evident upon one or the other of the joints alone, or may be quite absent as seems to be more commonly the case in the males. Similarly Brölemann (Ann. Ent. Soc. Fr., 1896, pp. 48-49) in arguing for the distinctness of transmarinus and mordax relies almost wholly upon secondary characters and does not inform us as to whether he is speaking of male or female. He says: "Pour ce qui est des deux espèces de Koch, il me semble qu'il ne peut y avoir de confusion, puisque le 4e article des pattes anales des mordax est trés court, trés renflè, parcouru en dessus par un profond et large sillon, ce qui n'est nullement le cas chez le transmarinus." But this is true only of males while the females conform to Brölemann's transmarinus, which must accordingly be regarded as the same species.

2. **Lithobius xenopus** Bollman.

1888. Lithobius xenopus, Bollman, Proc. U. S. N. M., XI, p. 350.

Locality.—Tallulah, Ga. (L. M. Underwood).

3. **Lithobius vorax** Meinert.

1872. Lithobius vorax, Meinert, Myr. Mus. Haun., II, p. 292.
1875. Lithobius vorax, Stuxberg, Öfvers. af k. Vet. Akad. Forh. no. 3, p. 26 and 32.
1885. Lithobius latzeli, Meinert, Proc. Am. Phil. Soc., XXI, p. 175.
1887. Lithobius clarus McNeil, Proc. U. S. N. M., X, p. 326.
——. Lithobius tyrannus, Bollman, ibid., p. 636.

Localities.—Byram, Fernwood, Watervalley, Canton, Holly Springs, Grenada, Jackson, Biloxi (type locality), Longbeach and Ocean Springs, Miss.; Pensacola, Fla. (clarus McNeil); Jackson and Birmingham, Ala.; Brown's Summit, N. C.; Crandall, Marksville and Luray, Va. (latzeli, seq. Meinert and Bollman.)

There is marked variation in this species in the development of the claws of the penult legs. There is a distinct anterior or third claw in the specimens from some localities (such as Holly Springs, Fernwood, Longbeach, Miss., and Jackson, Ala., etc.) which seems to be especially well developed in younger or smaller specimens (cf. clarus McNeil) but which is readily broken off and tends in older specimens to become relatively reduced, obsolete or absent. Because of this it would seem justifiable to regard clarus as having been based upon small specimens of this species since no other difference appears in the description given. Specimens from North Carolina and Virginia seem to show a tendency for the coxal pores to be round or oval rather than strongly transverse more frequently than in specimens from the Gulf region; but there are no constant differences in this respect and both extremes with intermediates are to be found in the more southern localities. Hence, no grounds in this direction appear why L. latzeli should be kept apart from vorax. The longitudinal sulcus which Meinert mentions as occurring on the ventral surface of the third and fourth joints of the anal legs in latzeli is present in all specimens of vorax. The sulcation on the mesal surface of the tarsal joints of anal and penult legs mentioned by Bollman as distinctive of his tyrannus is present in most specimens of vorax. The articles of the antennae vary greatly in number with the size of the individual, from twenty-six or twenty-seven in young specimens fourteen or fifteen millimeters in length to above forty in the largest adults. The average number in medium size adults would seem to be about thirty-five or thirty-six.

34. **Lithobius underwoodi** Bollman.

1888. Lithobius underwoodi, Bollman, Proc. U. S. N. M., XI, p. 350.

Localities.—Maplesville, Selma, Morgan, Thomasville, Jackson, and Anniston, Ala.; Atlanta, Tallulah Falls, (and Macon, type locality, seq. Bollman), Ga.; Landrum and Seneca, S. C.

Especially abundant in Alabama where it seems to be the most common of the larger species.

35. **Lithobius rex** Bollman.

1888. Lithobius rex, Bollman, Procl U. S. N. M., XI, p. 350.

Locality.—Tallulah, Ga. (L. M. Underwood).

36. **Lithobius carolinae** sp. nov.

Medium or slender.

Dorsum brown to brownish yellow; head much darker, chestnut; prosternum dark brown; antennae bark brown, pale or rufous distally; legs light brown or yellow, the posterior pairs darker but light distally; venter pale.

Antennae short; composed of thirty to thirty-five articles.

Ocelli about ten or twelve, arranged in three series; thus, 1+4, 3, 3.

Prosternal teeth 2+2.

Angles of the sixth, seventh, ninth, eleventh and thirteenth dorsal plates produced.

Coxal pores 3, 4, 4, 3, round.

Last two pairs of coxae laterally armed, last three pairs dorsally armed.

Spines of first legs 0, 0, 1; of penult 1, 3, 2, 1, with two claws; of the anal 1, 3, 2, 0, or rarely 1, 3, 2, 1, also with two claws.

Claws of gonopods in female tripartite; basal spines 2+2.

Length 8–9.5 mm.; width of tenth dorsal plate 1.2–1.5 mm.

Localities.—Asheville and Hot Springs, N. C.; Landrum and Taylor's (var.), S. C.; Russellville, Tenn.

This species would seem to be related to L. juventus of Bollman, but the sixth dorsal plate has the posterior angles more or less produced and the spining of the legs is constantly different.

37. **Lithobius arienus** sp. nov.

Robust.

Dorsum brown; head together with anterior and posterior plates darker, not reddish; antennae brown, darkened distad; legs pale yellow, the posterior pair darker; venter pale, the prosternum and posterior plates slightly darker.

Antennae moderately long; composed of thirty-four articles.

Ocelli compactly arranged in four longitudinal series; thus 1+4, 4, 3, 3, a total of fifteen; ocelli of the two upper rows larger.

Prosternal teeth 2+2.

Sixth, seventh, ninth, eleventh and thirteenth dorsal plates with the posterior angles produced.

Coxal pores ad 3, 4, 4, 3, round.

Last two pairs of coxae laterally armed, the last three pairs dorsally armed.

Spines of the first legs 0, 1, 1; of the penult 1, 3, 3, 2, armed with two claws; of the anal 1, 3, 2, 1, also armed with two claws.

Length 11.5 mm.; width of tenth plate 2 mm.

Locality.—Hot Springs, N. C.

One male. Very close to carolinae but conspicuously larger and more robust and differing in the spining of the legs, in the ocelli, in coloration, etc.

Genus **Bothropolys** Wood.

But one species of this genus occurs in the United States east of the Rocky Mountains.—B. multidentatus.

38. **Bothropolys multidentatus** Newport.

1845. Lithobius multidentatus, Newport, Tr. Linn. Soc., XIX, p. 365.
1862. Bothropolys nobilis, Wood, Journ. Acad. Sci. Phil. V, p. 15.
1865. Bothropolys multidentatus, Wood, Tr. Am. Phil. Soc., XIII, p. 152.
1875. Lithobius multidentatus, Stuxberg, Ofvers. af k. Vet. Akad. Forh.
1887. Lithobius multidentatus, Bollman, Proc. U. S. N. M., p. 263.

Localities.- Canton, Fernwood, and Byram, Miss.; Maplesville and Jackson, Ala.; Catawba, N. C.; Russellville, Tenn.; White Sulphur, W. Va.; Chatham and Balcony Falls, Va.

This species is widespread in the southern states though apparently not so common as farther north. In the section from Virginia to New York state, etc., it is abundant as it is also in corresponding latitudes farther west.

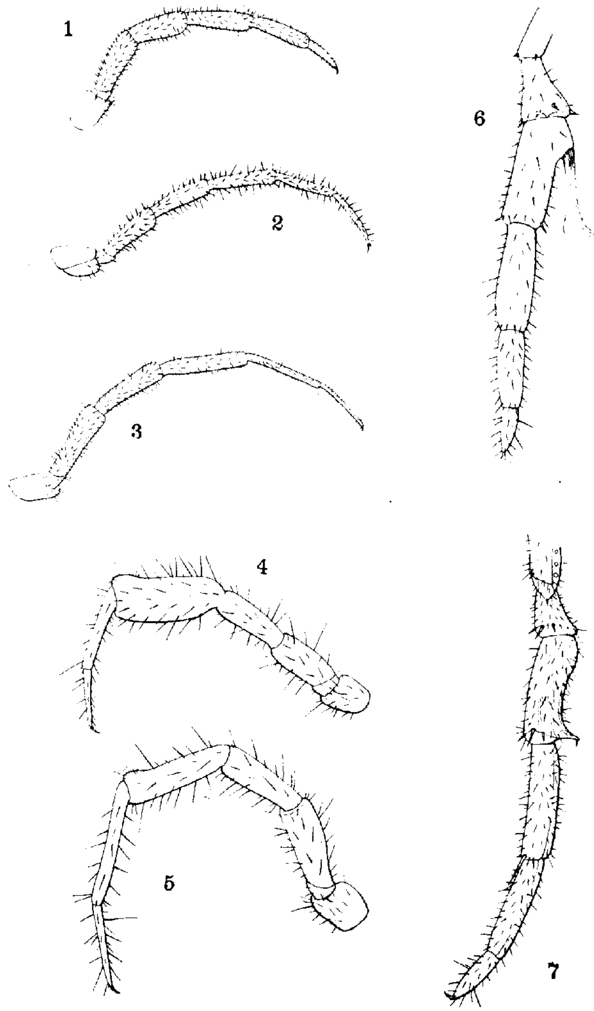
EXPLANATION OF PLATES.

PLATE 3.

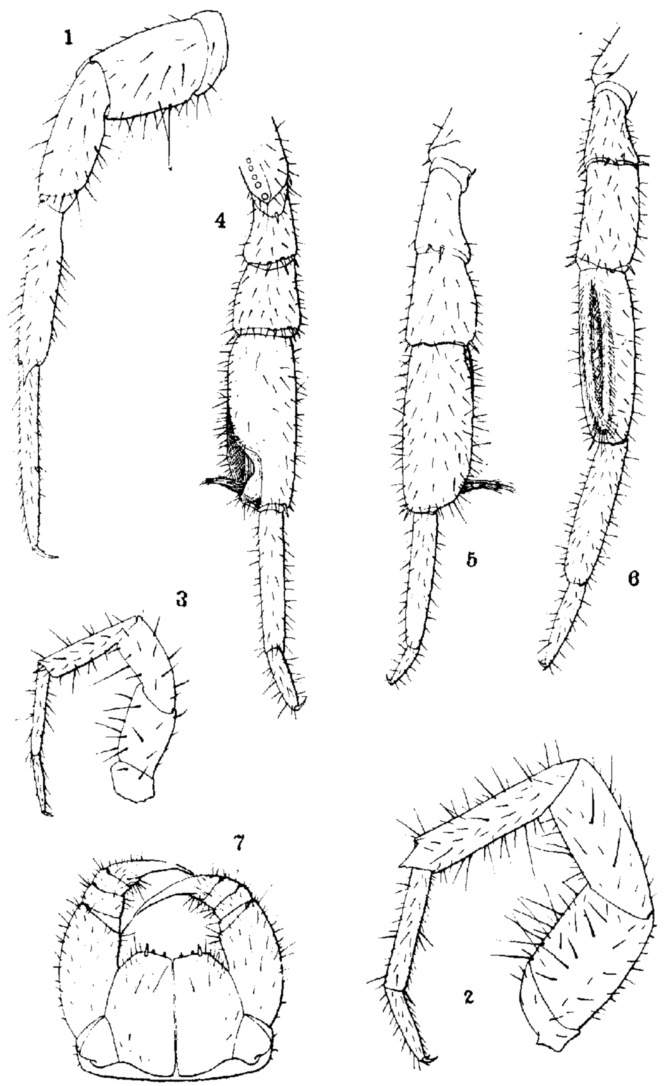
FIG. 1. Left anal leg of Lamyctes fulvicornis from the exterior. From specimen 9.6 mm. in length taken at Haugen, Wisconsin.
FIG. 2. Left anal leg of Lamyctes tivius sp. nov. From a specimen 6.6 mm. in length taken at Jackson, Ala. Same magnification as preceding.
FIG. 3. Left anal leg of Lamyctes pinampus. From a specimen 8.6 mm. long taken at Claremont, Cal. Same magnification as the preceding.
FIG. 4. Right anal leg of Watobius anderisus. Specimen from Thomasville, Ala.
FIG. 5. Right penult legs of Watobius anderisus. Same specimen as preceding.
FIG. 6. Left anal leg of Lithobius paitius sp. nov., dorsal aspect.
FIG. 7. Left anal leg of Lithobius tuobukus sp. nov., dorsal aspect.

PLATE 4.

FIG. 1. Right leg of the fifth pair of Buethobius oabitus sp. nov., cephalic aspect
FIG. 2. Right leg of the fifth pair of Zygethobius pontis sp. nov.
FIG. 3. Right leg of the fifth pair of Watobius anderisus sp. nov., cephalic aspect
FIG. 4. Left penult leg of Lithobius manegitus sp. nov., ventral aspect.
FIG. 5. Left penult leg of Lithobius manegitus sp. nov., dorsal aspect.
Fig. 6. Left anal leg of Lithòbius manegitus sp. nov., dorsal aspect.
FIG. 7 Prosternum of Lithobius manegitus sp. nov., ventral aspect.



R. V. Chamberlin.



R. V. Chamberlin.

NOTES ON THE SYNONYMY OF THE GENERA INCLUDED IN THE TRIBE LACHNINI.

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In taking up the preliminary work on what I term the sub-family *Lachninae* it is very hard to ascertain the correct standing of several of the genera in the tribe *Lachnini* both from a standpoint of literature and classification.

Beginning with the original description of the genus *Lachnus* the author will discuss the later genera as erected and invites further discussion in order that the correct generic names may be used in the future.

The genus *Lachnus* Burmeister. Illiger is credited with the genus, but in reality it belongs to Burmeister and was published in 1835 in his Handbuch der Entomologie, p. 91.

"3 (13) Gatt Lachnus Ill.
Aphis autor.

Eh. Fuhler deutlich sechsgliederig, kurzer als der Leib. Das erste und zweite Glied kurz und dick, das dritte sehr lang, das vierte 2-3 kurzer, das funfte etwas langer als das dritte, das sechste klein, zugespitzt bei einigen Arten wie am Ende zusammen geschnurt und scheinbar ein eigenes Glied bildend. Flugel mit starker Randrippe. Hinterleib ohne Honigrohren hochstens mit zwei Hockern an deren Stelle."

Under this genus Burmeister gives seven species as follows:

1. *Lachnus lapidarius*, (Fab.), which appears to be an unrecognizable species.

2. *Lachnus fagi*, (Linn.), which is now the type of the genus *Phyllaphis* Koch.[1]

3. *Lachnus quercus*, (Linn.), which is now the type of the genus *Stomaphis* Walker.[2]

4. *Lachnus fasciatus*, Burmeister, which Del Guercio has recently placed in his Genus Lachniella.[3]

5. *Lachnus Punctatus*, Burmeister, which up to the present time has not been definitely recognized (may be viminalis Boyer).[4] (?)

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1. Koch, Die Pflanzenlause Aphiden, 1857, p. 248.
2. Walker, The Zoologist, 1870, Vol. 28, p. 2000.
3. "Redia," 1909, Vol. 5, fasc. 2, pp. 173-359.
4. Boyer, Ann's Ent. Soc. France, 1841, p. 184.

Then he mentions *Aphis pini* aut. and *Aphis betulae* autor to go in this genus but as no reference is made to any one author neither species can have a valid standing in this genus.

As one of the species originally cited under the genus must hold for the type of that genus then must one of the four valid species be that type.

Two of the four are unquestionably removed as types of the genera *Phyllaphis* and *Stomaphis*, thus leaving only two for the genus Lachnus.

Lachnus punctatus if found to be distinct is the only species which has not been definitely recognized and placed in a different genus by the later writers, and it is the only species left for the type of the genus.[5] Unless this species is located the genus *Lachnus* must revert to the group containing *L. fasciatus* Burm. as a type.

A careful study of *Lachnus viminalis* Boyer, Boyer's description of that species, and Burmeister's description may (?) show that *L. viminalis* Boyer is identical with *L. punctatus* Burm. In that case *Lachnus* will be definitely established with *L. fasciatus* as the type. If not then what is the genus and what species can we refer to that genus?

On the other hand in 1908 Mordilko[6] used L. viminalis Boyer to form a new genus *Tuberolachnus*. Should this species prove to be *L. punctatus* then *L. fasciatus* Burm. must be the type of the genus *Lachnus* Burm., as it is the only species of those cited by Burmeister left in that genus. Since *L. fasciatus*, according to Del Guercio at aut., is a valid species I hold that this species under the existing conditions must hold as the type.

The next genus taken up in this tribe was *Cinara* Curtis, as follows:

The genus *Cinara* Curtis.
type *A. pini* Linn.?
He includes *A. roboris* Linn.

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5. April, 1910. Entomological News. The author gave *Lachnus punctatus* as the type of the genus Lachnus because it seemed to be the only species which was left for that genus, and at that time I was unaware of the fact that Mordwilko (Annuaire Music Zoologique de L'Academie Imperiale des Sciences, Vol. 13, 1908, p. 374) had used *Lachnus viminalis* as the type of his genus *Tuberolachnus*. It is impossible, however, with the present knowledge of the two above species to more than place *Lachnus punctatus* as a doubtful synonym of *L. viminalis* for *Lachnus punctatus* apparently cannot be clearly determined, and Boyer's description of *L. viminalis* is too clear to be put aside.

6. Annuaire Musie Zoologique de L'Academie Imperials des Sciences, vol. 13, 1908, p. 374.

This genus was formed in 1835 by Curtis, section 576, Vol. 12, of his British Entomology.

He places two species in the genus, *Aphis pini* Linn.?, and *Aphis roboris* Linn. The first he gives as the type, but as he places a question mark after Linn., the species is not valid, and *A. roboris* Linn. which he describes in full is the type of the genus? The generic names erected for that species since that time are synonyms?[7] He gives the figures of the adults, some of the parts, and also gives a good description.

The synonymy of this genus would then be

Cinara Curtis 1835
Pterochlorus Rondani 1848.[8]
Dryobius Koch 1855 Loc. cit.

Dryaphis Amyot[9] which Del Guercio Loc. cit. p. 262 has given genus rank never was a genus name until given that rank by Del Guercio. If we were to accept Amyot's names which were mononomials and in this case means "Oak Aphid" there would never be an end to the changing of names. The late workers on the *Hemiptera* refuse to look upon the work of Amyot except as a curiosity.

The next genus to be formed in the Lachnus group was Stomaphis Walker loc. cit. with *A. quercus* Linn. as the type and there is no discussion necessary on this genus name as it is well established.

Mordilko loc. cit. in 1908 deemed it necessary to erect two new genera in this group, Schizolachnus Mord. with *A. tomentosus* DeGeer as the type and *Tuberolachnus* Mord. with *Lachnus viminalis* Boyer as the type.

In 1909 Del Guercio loc. cit. has placed both of the above species in the genus *Lachnus* regardless of the fact that neither were in the original genus and he removes to other genera all of the original included species. If it is true that *L. viminalis* Boyer and *L. tomentosus* DeGeer are both in the same genus then must *Tuberolachnus* be the genus name with Schizolachnus as a synonym and *L. viminalis* Boyer as the type.

7. The question of the validity of this genus rests upon the fact that Curtis did not give *roborus* as the type and the other species is questioned. The author then concludes that the genus is in question and cannot be placed as a valid genus.

8. Esapodi afidicidi in Nuove Ann. di Sci. Nat. Bologna, 1848.

9. Ann. Soc. Ent. France vol. 5, ser. 2, p. 481, 1847.

In 1909 five new genera were formed in this group, one of which must be a synonym and a second which would according to the reasoning of this article also be a synonym.

The genera are *Eulachnus* Del Guercio (loc. cit.), the type of which probably should be *E. Agilis* (Kalt.)

Lachniella Del Guercio (loc. cit.), the type of which is not set, and is, I consider, a synonym of Lachnus?

Essigella Del Guercio (loc. cit.) with *E. californicus* (Essig) as the type.

Davisia Del Guercio (loc. cit.) *L. longistigma* Monell as the type and which is a synonym of the following genus. (Nov. 13, 1909).

Longistigma Wilson [10], type *L. caryae* Harris which I have published as synonymous with *L. longistigma* Monell and L. *platinicola* Riley. (Nov. 1, 1909.)

According to the evidence shown here using Del Guercio's arrangement to generic characters, the correct synonymy is as follows:

1. *Trama* Heyden
   type *T. troglodytes* Heyd.
2. *Stomaphis* Walker
   type *S. Quercus* (Linn).
3. *Pterochlorus* Rondani
   Syn. *Cinara* Curtis?
   Syn. *Dryobius* Koch.
   Syn. *Dryaphis* Kirk
   type *P. roboris* (Linn.)
4. *Essigella* Del Guercio
   type *E. californicus* (Essig.)
5. *Longistigma* Wilson
   Syn. *Davisia* Del Guercio
   type *L. caryae* (Harris).
6. *Tuberolachnus* Mord.
   ? Syn. *Schizolachnus* Mord.
   type *T. viminalis* (Boyer).
7. *Lachnus* Burmeister.
   Syn. *Lachniella* Del Guercio
   Type *L. fasciatus* Burm.
8. *Eulachnus* Del Guercio
   type *E. Agilis* (Kalt).

In the December, 1910, issue of the ANNALS the author published a paper on the genera of the subfamily *Aphidinae* and wishes here to note two corrections.

The type of the genus Illinoia should read *m. liriodendri* Monell. The type of the genus *Hyalopterus* Koch should read *A. pruni* Fab. instead of *aurantiae* Koch.

10. Can. Ent., vol. 41, p. 385, 1907.

SUMMARY OF FOOD HABITS OF AMERICAN GALL MIDGES.

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Our understanding of this group will be much clearer if we recall that it is an offshoot from the Mycetophilidae, the species of which subsist largely upon decaying vegetable matter or low forms of vegetable life. The family Itonidae, better known as the Cecidomyiidae, has attained its present large proportions not by reason of strength, great resistant powers or unusual fecundity, but through an amazing adaptability. We find larvae in decaying vegetable matter, in dead wood, on fungus, affecting all parts of a very great variety of the higher plants and presenting thereupon almost every conceivable grade in the development of the gall, living as parasites at the expense of very small insects or even preying upon their near allies. Broadly speaking, taxonomic studies in this family show at least a moderately close relationship between specialization in structure and divergence in the food habits from those of ancestral forms.

We have no firsthand knowledge of the food habits of the tribe Lestremiinariae, though there is every reason to believe that there is substantial agreement in this regard with European species, which have been reared from decaying vegetable matter.

We can supply a little definite information respecting the food habits of the tribe Campylomyzariae, since representatives of several genera have been reared. Mycophila fungicola, an undescribed species, referable to a new genus was reared from fungus, while Monardia lignivora Felt was obtained in considerable numbers from the fungous-affected heartwood of white pine. Cordylomyia coprophila is an undescribed species referable to a genus which will be erected shortly. It was reared from manure. These few records show that this comparatively generalized tribe subsists upon fungi, fungous-affected wood and certain forms of vegetable matter. These food habits agree in general with those of European species, and further observations will doubtless show that members of the tribe as a whole, depend for nourishment on the lower plants or upon the tissues

of the higher plants after invasion by fungi or the commencement of decay.

The subfamily Heteropezinae comprises a number of remarkable, and taxonomically speaking, ancient forms. The species live largely, if not exclusively, in ligneous tissues in the incipient stages of decay. Miastor larvae, presumably those of M. americana Felt were found in numbers in the moist, partially decayed inner bark and sapwood of chestnut. The majority of the European species studied, develop under practically similar conditions.

Our title implies a limitation to gall-making forms. This is true of the vast majority of the members of this family, though not applicable to the two subfamilies just discussed or to the lowest tribe of the Itonidinae now under consideration. The members of this tribe, the Epidosariae, distinctly allied with the more generalized forms in this family by the presence of a well developed crossvein and yet exhibiting a connection with the higher forms because of the universal presence of highly specialized circumfili, do not produce galls but live in dead, frequently dried, woody tissues. The detection of the larvae is consequently difficult and, as a result, rearings have been comparatively few. Winnertzia pinicorticis Felt was obtained by Mr. Pergande from the bark of Pinus inops. The genus Colpodia, with its remarkably long, narrow wings, probably lives in dead wood, a habit known to be true of Asynapta saliciperda Felt which was reared from old Rhabdophaga batatas O. S. galls on willow.

The most generalized of the true gall-making forms are probably found in the tribe Dasyneuriariae, the genus Rhabdophaga Westw. being the less specialized of this group. A study of this genus shows at once a marked partiality to Salix, a genus placed rather low in the series of flowering plants, and the production thereupon of a number of comparatively simple deformities such as bud and subcortical galls. It is pre-eminently a genus of the willow. Dasyneura Rond. comes next. An examination of the records shows that a large proportion of the species live in comparatively simple leaf and bud galls on various genera of the higher flowering plants, an interesting exception being the remarkable D. flavotibialis Felt which was reared from decaying wood, while D. rhois Coq. was obtained from a root gall on Sumac. The peculiar Lasiopteryx

coryli Felt was reared from leaf folds on hazel, Corylus virginica. An undescribed species of Cystiphora Kieff. was reared from a very inconspicuous swelling on Viburnum leaves. A departure from the normal food habit in this tribe is seen in Coccidomyia pennsylvanica, an undescribed species belonging to a new genus and reared from Lecanium scales.

This series of generalized gall-making forms is continued in the tribe Oligotrophiariae, separated from the preceding only by the simple claws. The more generalized genus, Phytophaga Rond. exhibits a connection with the preceding tribe in the possession by P. destructor Say., of claws with rudimentary teeth. As is well known, it hardly makes a gall, depending for protection upon the leaf sheath. P. ulmi Beutm. occurs in the buds of elm, P. violicola Coq. curls the leaves of violet, while several species of this genus typified by P. rigidae O. S. live upon Salix, making galls similar to those produced by species of Rhabdophaga. Janetiella asplenifolia Felt was reared from a fleshy fold on the midvein of sweet fern, while J. brevicauda Felt was obtained from the typical gall of Lasioptera vitis O. S. on grape. The genus Oligotrophus Latr. is represented by the European O. betulae Winn., which affects the seeds of birch, while O. salicifolius, an undescribed species produces a flattish, ovoid gall on Salix leaves. The genus Rhopalomyia Rubs. contains a large number of species and exhibits a marked partiality for Solidago, producing upon various species of this plant genus a considerable number of flower and bud galls, the large rosette deformities of apical buds being characteristic. A few species of this genus also occur upon the allied aster and Artemisia. The larger species of Sackenomyia Felt are restricted to Salix, while one small species at least, has been reared from Viburnum. Walshomyia Felt is found in the fruit of Juniperus.

The tribe Lasiopterariae exhibits a high degree of specialization in venation at least, and we find in this group a marked restriction in food habits. The genera Lasioptera Meign. and Neolasioptera Felt live almost exclusively in subcortical stem galls, a large proportion of the species occurring upon Solidago, though a considerable variety of other plants are subject to attack. Asteromyia Felt, like the two preceding genera, exhibits a marked preference for Solidago, though a number of species occur upon aster. It is noteworthy that a large major-

ity of the galls produced by this genus are of the apparently fungous-affected blister type. The highly specialized Clinorhyncha Loew is represented in America by several species probably restricted to the florets of Yarrow, Thoroughwort and presumably Chrysanthemum. The peculiar Camptoneuromyia adhesa Felt has been reared from oval, adherent galls between Solidago leaves, while C. rubifolia Felt was obtained from a marginal leaf roll on blackberry.

The tribe Asphondyliariae is a rather highly specialized group, the species living mostly in buds. This is particularly true of Asphondylia H. Lw., a genus practically confined to buds and apparently not closely restricted in food habits, since different species have been reared from a considerable variety of plants. Schizomyia Kieff. is allied to the preceding genus and the several species reared were obtained from buds; such as S. coryloides Walsh and Riley from an apical leaf bud gall on grape, and S. pomum Walsh and Riley from a nutlike polythalamous grape gall, evidently a modified bud. S. rivinae Felt was reared from bud galls on Rivina. Cincticornia Felt appears to be restricted to leaf galls on Quercus, the largest and perhaps most characteristic being that produced by C. pilulae Walsh. A series of rearings have resulted in obtaining a number of species, all from various leaf galls on this plant genus.

The tribe Itonidinariae comprises a large assemblage of highly specialized forms, easily divided by the circumfili into two groups, namely the bifili and trifili. The former is represented by Endaphis Kieff. first recorded as an endoparasite on Aphididae and reared by us from mite infested foliage. Contarinia Rond. also belongs in this subtribe and, as is well known, displays a marked preference for bud and fruit structures. C. johnsoni Sling., C. virginianeae Felt, C. rumicis H. Lw., C. sorghicola Coq. and C. pyrivora Riley, all being representative in food habit. Thecodiplosis Kieff. is closely allied to the preceding and is represented in America by T. quercifolia Felt reared from oak, T. ananassi Riley reared from a twig gall on Taxodium, and T. liriodenri O. S., inhabiting a blister gall on tulip leaves. Dentifibula Felt, also in this subtribe, has at least one species, D. cocci Felt, which is zoophagous.

The subtribe trifili comprises the remainder of the genera in the family. The genus Bremia Rond., representated by several American species, is probably phytophagous. Aphidoletes Kieff. contains several American species, a few of which at least are known to prey upon Aphididae. It is possible that our American species of Lobodiplosis Felt, Coquillettomyia Felt, and Karschomyia Felt have habits similar to those of the allied Mycodiplosis Rubs., the majority of the species of which appear to subsist upon fungi, though one, M. acarivora Felt preys upon Tetranychus. Youngomyia Felt displays a preference for the buds of various plants. Species of Clinodiplosis Kieff. have been reared from leaf galls on scrub oak, Spiraea, Carya, and from roots of Cattleya. It is probable that the species occurring on hickory leaves is an inquiline. The genus Caryomyia Felt comprises a number of homogeneous forms producing a considerable variety of galls on hickory leaves. We have yet to obtain undoubted evidence that members of this genus live upon any other plant. Prodiplosis floricola Felt has been reared from enlarged blossoms of spiraea and clematis. Arthrocnodax Rubs. is represented by several American forms, A. apifila Felt occurring in bee hives and probably subsisting upon organic debris, though subsequent investigations may show it to be predaceous. Hormomyia H. Lw. comprises a number of large forms usually found in the vicinity of swamps and presumably living mostly on sedges or allied vegetation. Four species, hardly typical of the genus, namely H. crataegifolia Felt, H. canadensis Felt, H. clarkei Felt and H. verruca Walsh have been reared from leaf galls respectively, on Crataegus, Amelanchier, Spiraea and Salix. The European Monarthropalpus buxi Lab., producing an oval swelling upon the leaves of Box has been recently detected in this country. Giardomyia menthae Felt was reared from a pustule-like gall in the axil of the leaf of Mentha canadensis. Lestodiplosis Kieff. is represented by a large series of mostly spotted-winged midges which have been reared from a considerable variety of plants. The larvae of some at least, are known to be zoophagous and it is probable that most of the reared American forms prey upon the larvae of gall-making midges. The genus Itonida Meign,. better known as Cecidomyia Meign., comprises a large number of forms inhabiting for the most part, flower, bud and leaf galls on the higher flowering plants, though I.

resinicola O. S. and I. resinicoloides Wlms. occur in exuded pitch masses on pine, while I. tritici Kirby is well known as a species of prime economic importance.

A study of our records from a botanical aspect reveals several facts of interest. We note first that American gall midges live at the expense of some 177 plant genera belonging to 66 plant families. They afford support to some 538 species of gall midges representing 44 genera. These forms are known to inhabit 44 fruit (botanically speaking), 146 bud, 218 leaf, 130 stem, and 4 root galls. The paucity of root galls must be attributed in a measure to the difficulty of finding them. In addition to the above some five species were reared from unknown plants and eleven zoophagous species belonging to three genera, making a total of 47 insect genera comprising some 554 species, 441 of these having been reared from either plants or animals. Reference to our records shows that the Compositae supports a very large fauna, 22 of its genera affording sustenance to 118 species of gall midges belonging to some 15 genera. The majority of these midges, 55 species occur in bud, 32 in leaf, 30 in stem, while 5 inhabit fruit galls. The Salicaceae, represented only by Salix and Populus, supports some 59 species of gall midges referable to 15 genera, by far the greater number occurring upon Salix. As in the Compositae, a large proportion, 21 species occur in bud, 15 in leaf and 21 in stem galls, only 1 living at the expense of the fruit. The Rosaceae appears to be the next plant family favored by gall midges, 10 genera being subject to attack by 43 species of midges, assignable to 14 genera, 3 species inhabiting fruit, 12 bud, 25 leaf and only 3, stem galls. The Gramineae, despite its numerous genera and wide distribution has but 18 genera at present known to support some 25 species of midges representing 12 insect genera, 8 species occurring in fruit and 17 in stem galls. This is probably only a small proportion of the forms occurring upon grasses. Our record for the Cyperaceae is even more unsatisfactory, only one species, presumably inhabiting a stem gall being known. The paucity of records in both of these families is probably due to the difficulty of finding the galls. There is a close parallelism between the Juglandaceae and the Fagaceae, two genera in each being affected by gall midges. Juglans and Castanea are known to be infested by one and three species respectively,

while Carya and Quercus are subject to attack by 25 and 21 species, the former affording support to representatives of 5 and the latter to species belonging to 7 genera. These two trees are likewise comparable in that each supports but one species in the fruit, while by far the greater majority of the midges, namely 23 and 18 respectively, produce leaf galls. The large family Leguminosae has 13 genera which support some 5 genera of gall midges referable to 20 species, 3 living in fruit, 3 in bud, 6 in leaf and 8 in stem galls. Only 6 genera in the Urticaceae are attacked by gall midges belonging to 4 genera representing 8 species, 2 living in bud, 9 in leaf and 6 in stem galls. In the Vitaceae, Psedra, and Vitis support some 12 genera of gall midges representing 17 species; 4 inhabit bud, 12 leaf and 1 root galls. By far the great majority of the species, 15, occur upon Vitis. The large family of Labiatae supports some 6 genera representing only 13 species, the Caprifoliaceae, 8 genera comprising 14 species, and the important Pinaceae 6 genera and 14 species. The above record, while dealing with a much larger number of species than we have been accustomed to think occurred in this family, shows that in all probability there are many forms yet to be discovered.

Comparing the above data with recently summarized records* it will be seen that the food habits of some 420 European gall midges representing 43 genera are unknown. The Pinaceae afford sustenance to 11 species belonging to 4 genera, a condition closely paralleled in this country. The European Gramineae support some 20 gall midges representing 7 genera, a showing somewhat below what obtains in America. Conversely, the European records for the Cyperaceae include 4 genera and 9 species, while in this country but one species has been reared from Scirpus. The European Salicaceae supports some 30 species of midges belonging to 6 genera, 5 of these occurring on poplar. There appear to be no species affecting the Juglandaceae in Europe. There are nearly as many genera and species, 20 and 7 respectively, occurring upon the Fagaceae in Europe as in America, though the distribution is different, since Fagus supports 5 species referable to 3 genera and Quercus has only 14 species representing 4 genera, a marked contrast to conditions obtaining in this country. There is a pronounced differ-

*1909, Houard, C. Les Zoocecidies des Plantes d'Europe.

ence in the European Rosaceae, especially marked in Spiraea with its 2 genera and 5 species, contrasting strongly with our 8 genera representing 11 species. A still greater difference is found in the Vitaceae, the European Vitis supporting but 2 genera and 2 species, while our American vines afford sustenance to 12 genera represented by 15 species. The European fauna of the Compositae is also much less, namely some 67 species representing 10 genera as compared with our 118 species assignable to 15 genera. This large discrepancy is accounted for in great part by the enormous fauna of the Solidago and the numerous species occurring upon aster; plant genera which in Europe support only one genus and one species.

THE STRUCTURE AND SYSTEMATIC IMPORTANCE OF THE SPERMATOPHORES OF CRICKETS.

J. P. Jensen.

In several groups of animals, we find that the spermatozoa are held in packets or masses, and in some such as the Cephalopods, there is high specialization of the spermatophore, as the organ is called, in which the spermatozoa are contained. Among the insects, only representatives of a few groups form spermatophores, but when present they are beautiful and interesting structures and those formed by the gryllids or crickets are especially so.

While engaged in research work on crickets in the Entomological Laboratory of Cornell University, I noticed one day that a female Gryllus had a small pear-shaped organ attached between the ventral surface of the base of the ovipositor and the posterior end of the 8th abdominal sternite (Fig. 1). This structure did not seem to be part of her own body and as I did not at the time know anything about spermatophores, I was very much puzzled by it. After investigating the literature I found that I had happened to collect the specimen before the spermatophore had dropped off, and upon examining several males, I found a similar organ in situ in most of them, just outside of what was considered the genital opening and covered by the ends of the posterior sclerites.

Crickets, such as members of the genera Gryllus, Nemobius and Oecanthus are very difficult to classify and I had encountered considerable difficulty in obtaining good specific characters. More with a view of determining whether the spermatophores might not assist me in classifying them, than expecting to make any morphological discoveries, I commenced to study them somewhat thoroughly.

The literature was searched for accounts of copulation in these and related insects and five references were found. Serville stated that in copulation the female Gryllus mounts the body of the male, as in the Oecanthids. Peytoureau said that in the Locustidae the transfer of spermatozoa takes place by means of a pear-shaped spermatophore that is transferred to the

female in copulation. Packard mentioned that in the two families of Gryllidae and Locustidae this was true and that especially Gryllus had been noticed to have this habit. Gillette in 1904 gave an excellent illustrated account of the structure and transfer of the spermatophores of the Western Cricket, Anabrus simplex, family Locustidae, and the most complete was found to be an account by Lespes in 1855, who not only noticed carefully the complete process of copulation but by dissection he determined how the spermatophores were developed and to some extent the function of the parts of the spermatophore.

After relaxing some of my specimens of Gryllus, I dissected out the spermatophores in several males to gain a good knowledge of their structure. The spermatophore proper (Fig. 2, A) is attached to a handle-shaped part (Fig. 2, B) possessing five lateral hooks, three in front and two behind. The function of these hooks was not understood at the time but will appear later. A long whip-like part (Fig. 2, C) is attached to the dorsal side of the handle. Many males were examined and a spermatophore was almost always found present. This is in accordance with Lespes' observations, who found that a new spermatophore was completely formed in about one hour and that each female copulated several times during the egg-laying season.

To determine the function of the parts, the female that had this organ still attached was after relaxation carefully dissected. The function of the hooks on the handle was readily found to be for attachment. The anterior part of the handle was found to be inside of the vaginal opening and the three anterior hooks held it firmly in place. The two at the posterior end also curve up and serve to hold it firmly in place by clasping to some extent the basal part of the ovipositor. After removing the bulb of the spermatophore, I attempted to remove the handle, but the anterior hooks held too firmly, part of it broke off but the whip-like structure remained attached and when pulled out, showed that it had extended a considerable distance up the passage and as will soon be shown this would indicate that the spermatheca is quite far removed from the external opening. By mounting in glycerine and using high power the true relation of the whip-like part to the handle was made out, and also the nature and function of the former structure. It is attached somewhat nearer the spermatophore body than the middle of

the handle and is continued as a dorsal thickening of the handle into the narrow cylindrical attachment between the handle and the bulb. It is in fact a duct, whose cavity can be traced from a point some distance inside the bulb (Fig. 2, D) to its outlet at the end of the whip.

This was proven by embedding the tiny structure in paraffin and taking microtome sections of it (Fig. 3 and 4), from the farther end of the handle to almost the tip of the thread. The outside wall is rather gelatinous and soft, but a cylindrical, central core (Figs. 3 and 4, B) of very hard, apparently chitinous, material has the tiny duct in its center (Figs. 3 and 4, C) and in the sections this duct had not been flattened in the least. The very firm walls are no doubt for the purpose of preventing flattening or deformation, which might compress the duct and prevent the passage of the spermatozoa.

Last summer I again had opportunity to witness the courting and mating of Oecanthis fasciatus, and the process was very much the same as described by the writer in the *Canadian Entomologist*, Jan., '09. Then, however, I had missed the transfer of the spermatophore and after killing this female I removed the organ and mounted it in the usual way under a cover glass in canada balsam. Watching it under low power of the microscope I succeeded by judicious pressure, in causing the spermatozoa to flow out of the end of the "thread." This was final proof that this part of the organ is for conducting the spermatozoa to the spermatheca. Lespes in his account, somehow seems to have overlooked the fact that this thread-like structure is a duct, likely due to the minuteness of the duct itself, which when highly magnified, reminds one of a fine capillary tube. He calls it a horny thread, "filé corné." In fact he does not attempt to explain the structure at all, nor how the spermatozoa enter the vagina of the female from the spermatophore after it has been placed in position.

As before mentioned, the various species of crickets are very difficult to determine and the spermatophores may in the future be of considerable importance for definitely defining the species. For instance, Minnesota specimens of Gryllus pennsylvanicus Burm. vary considerably in general coloration and size from the Eastern specimens, but the spermatophores examined were all exactly alike. Lespes described and figured the respective spermatophores of the common European species, Gryllus

sylvestris, G. campestris and G. domesticus, and they differ very markedly from one another. Oecanthis fasciatus Fitch and O. quadripunctatus Beut. are the same species as gradations in the antennal markings show very nicely when one has considerable material. Whether the spermatophores further verify this, I have not as yet been able to definitely determine but it appears to me that the spermatophores of insects are worthy of considerable more attention than has been devoted to them in the past.

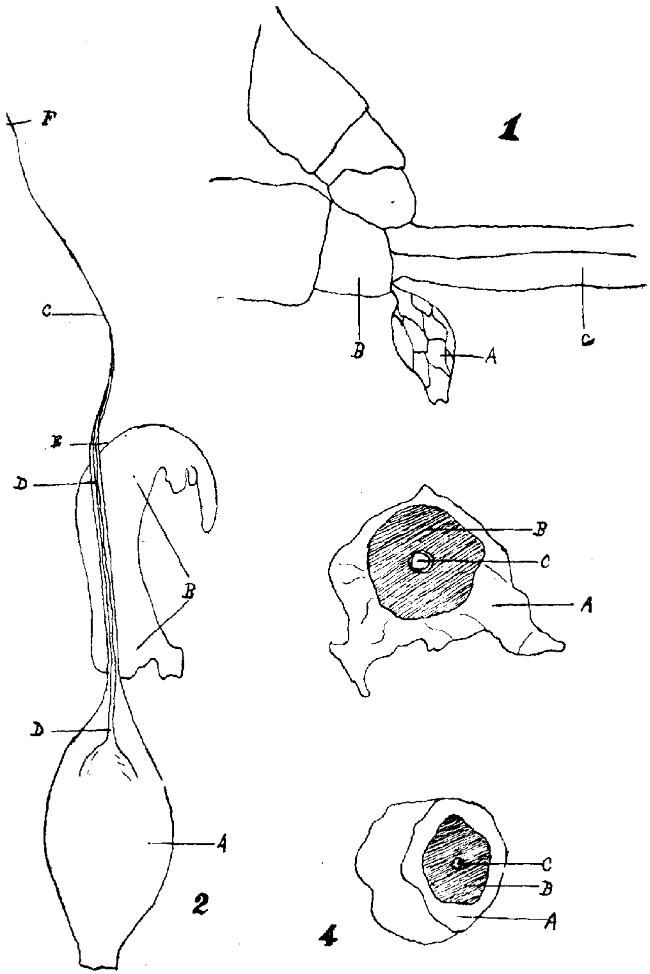
EXPLANATION OF PLATE V.

All figures magnified, 3 and 4 highly.

FIG. 1. Attachment of spermatophore to female Gryllus pennsylvanicus. A, bulb of spermatophore; B, 8th abdominal sternite; C, ovipositor.

FIG. 2. Spermatophore of G. pennsylvanicus, magnified. A, bulb; B. handle; C, thread-like part (Lespes "file corne"); D, duct; E, cross-section shown in Fig. 3; F, cross-section shown in Fig. 4.

FIGS. 3 and 4. Cross-sections of thread at E and F in Fig. 2. A, gelatinous outside wall; B, hard core; C, duct.



P. Jensen.

NOTES ON THE LIFE-HISTORY OF THE LARCH CASE-BEARER (COLEOPHORA LARICELLA.)

GLENN W. HERRICK.

This is an European insect that is gradually becoming quite widely distributed in the northeastern United States and parts of Canada. It is also evidently causing considerable injury to larch trees wherever it is present.

It was first noted in this country by Dr. Hagen, who, in 1886, recorded it as seriously injuring the European larches on an avenue in Northampton, Mass. In 1905, Dr. Fletcher recorded its injuries to larches in Canada and in 1906 Miss Patch says that the case-bearers have been present in certain counties in Maine and "although minute they have been present in such enormous numbers that larch trees have often been, during the past three summers, eaten bare of green early in the spring." The insect has been present on the larches in the vicinity of Ithaca for several years, and undoubtedly does considerable injury every season. The small green leaves are devoured in early spring as fast as they push out, and on many trees the green tissues are eaten out and the leaves left pale and bleached in early spring. As soon as the buds begin to break in the spring, the dark brown, cigar-like cases that have been lying quietly attached to the branches all winter, become suddenly animated and commence crawling to the tender green leaves. In the spring of 1910 we found them active and feeding by the 16th of April. Each larva selects a leaf and soon eats a circular hole through the epidermis, thus gaining access to the tender tissues within. Then holding its case at right angles to the leaf and never releasing hold of its case it mines to the right and left of the opening as far as it can reach. The mined portion of the leaf assumes a bleached appearance and the whole tree soon shows the effect of the injuries if the larvae are abundant. Observations would seem to indicate that the larvae molt just before leaving their winter quarters on the branches. This point, however, must await another season for definite determination. The cases of the larvae are enlarged after they have been feeding a few days by slitting the old case and inserting a piece of leaf in the slit and fastening it in with

silk. One larva must attack a great number of the small young leaves, for in cases observed the larvae were not abundant enough to do the damage they did unless each case-bearer attacked and injured several leaves. As bearing on this point I selected a branch 6 inches long and found that it bore 24 whorls of leaves, one whorl, at this particular stage, containing 54 small leaves and other nascent ones in the center that could not be counted. If we take 54 leaves as the average, the branch bore 1296 leaves that were of a size to be attractive to the larvae. On this branch were 10 case-bearers. They had injured every leaf on the branch except those in the last whorl evidently having begun near the base of the branch and worked outward. These ten larvae had probably attacked and injured over a thousand leaves the majority of which, of course, were small.

On April, 26th I found the first pupa in the breeding cages. When ready to pupate, the larvae attach their cases securely to the branches or to the leaves often in clusters of 4 or 5. A favorite place for attachment seems to be the center of a whorl of leaves. The period of pupation, in the breeding cages at least, proved to be from two to three weeks. We found moths emerging in the insectary May 11, 13, 15, 16 and on.

The moths begin pairing in a few days after emergence and on May 31, their pinkish-red eggs were found deposited on leaves in the breedings jars. The eggs are shaped as though moulded in a tea-cup with many ridges radiating from the upper and smaller end, for they are glued to the leaves by their bases.

On June 6th, in the field, an abundance of moths were found and many of them were pairing. Some had probably emerged a few days earlier. On June 10th I found eggs on the leaves in abundance but there were still many pupae in cases showing that the moths emerge over a long period. The eggs are evidently placed indiscriminately on either side of the leaves.

On June 28th and 29th the eggs were found hatching in the field. The egg-shells remain glued to the leaf and show no rupture of any kind for the emergence of the larva. Investigation shows that the larva bores through the base of the egg-shell and goes directly through the epidermis into the leaf beneath the egg. Here the larvae live mining in the tissues of the leaf but growing very slowly. The excrement of the tiny

larva is packed behind it in the mine. Here the larvae live until September. Owing to our absence from the University during the first part of September, we are unable to say at just what date the larvae first began to leave their mines and make their cases. On my return on the 15th of September many of them were found in their tiny cases feeding on the leaves. From this time on through September opportunity was given to observe them making their cases. In most instances, at least, they clean out their mines and pack the excrement in the outer end of it near the tip of the leaf. When the burrow is clean enough to suit them they cut off the tip of the leaf containing the excrement, which falls to the ground out of the way, and then they cut off enough of the leaf containing the clean part of the mine to make them a case of the desired length. The larvae now feed on the leaves of the larches until the latter part of October when they migrate to the branches and go into hibernation.

FURTHER BIOLOGICAL NOTES ON THE COLORADO POTATO BEETLE, LEPTINOTARSA 10-LINEATA* (SAY), INCLUDING OBSERVATIONS ON THE NUMBER OF GENERATIONS AND LENGTH OF THE PERIOD OF OVIPOSITION. II, ILLINOIS.

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In presenting for publication the results of a third successive year's observations on the biology of this insect made in the latitude of Urbana, Illinois and supplementing those made in Georgia in 1906 (Girault and Rosenfeld, 1907) and in Ohio in 1907 (Girault, 1908), it becomes necessary to state that little or no progress has been made in regard to the continuity of observation and experiment, so that they should still be classed as desultory. The observations were made in the open or east insectary of this office at Urbana under as normal conditions as possible, but during odd hours and without previous forethought or planning and subject to much neglect at a critical time toward the last.

They are presented, therefore, mainly to add to the sum of biological data on this insect, which in the end may lead to the discovery of important laws. At present, however, they form but a small beginning and cover but one or two biological factors; as they supplement to a large degree the observations made in Ohio (Girault, 1908), they are presented in the same general manner.

Those who gather data of this kind cannot help being impressed by our poverty in this respect and by the urgent necessity of accuracy in observation, to the minute as regards time and to the fraction of a degree as regards temperature, though it is true that such errors as occur should be chance errors, hence negligible. And most decidedly other factors should be taken into consideration, for in matters of this kind,

* This may seem a trivial matter but consistency demands that the specific name of this insect be written as it was originally by Say; I see no necessity for change or reason therefor and certainly stability in nomenclature is not aided by making one. See articles 15 and 19, The International Code of Zoological Nomenclature as Applied to Medicine (Stiles, 1905). If a change was necessary the form x-*lineata* would seem preferable to the other, being less radical. A. A. G.

we cannot foresee of what great importance the most trivial observations may become in the future and there is, doubtless, more than one cause for variability in periods of development.

SUMMARY.

The following paper merely contains additional biological data along the same lines as those presented previously, obtained during the season of 1908, together with an account of the breeding of adults in confinement which resulted in reproduction by the second generation of adults under adverse conditions. This reproduction by the second generation of adults apparently, was further hindered by actual starvation and was scanty, but the behavior of the beetles would lead to the belief that they were both willing and eager to reproduce. The fact is clearly shown that reproduction occurred with a pair of normal adults of the second generation, a result contrary to what we understand to be the meaning brought out by Tower (1906), discussed previously (Girault, 1908). We do not, however, make any claims, but the evidence is sufficient to establish the fact that *exceptionally* the adults of the second generation in normal beetles do develop the germ-cells before a period of hibernation.

THE EGG.

1. *Length of Stadium.**

The duration of embryonic development was determined for about nine hundred cases during the breeding season and the results are tabulated in Table I. The separate lots were confined as previously, in darkness. In every case recorded the time is actual, unless noted to the contrary. By comparing these records with those given by Girault (1908, Table I, p. 156), differences are noticeable in regard to the duration of the stage at the same approximate dates for the two latitudes; witness Lot I of the two tables. We should expect to find here a corresponding difference in the temperatures.

* This term is used in preference to *instar* which was originally proposed to designate the insect itself at any stage or period of development, as the egg instar, third larval instar and so on, just as we say the larva, caterpillar, pupa or imago.

TABLE I.

Duration of the Egg Stadium, Urbana, Ill., Season 1908.

Remarks.	Lot No.	No. eggs	Deposited			Hatched			Duration		Effective Temp. Daily Averages, Degrees Fahr.
			Month	Day	Time	Month	Day	Time	Days	Hours	
Pair No. 3 Hib. adults ..	1	58	May	29	11:45 a. m.	June	5	9:45 a. m.	6	22	24.47°
" 3 " ..	2	49	"	30	1:30 p. m.	"	6	11:30 a. m.	6	22	25.41°
" 1 " ..	3	18	June	4	7:00 p. m.	"	9	7:00 p. m.	5	..	34.24°
" 1 " ..	4	48	"	8	10:45 a. m.	"	14	6:30 p. m.	6	7¾	26.9°
" 1 " ..	5	43	"	9	3:00 p. m.	"	16	12:00 m.	7	9	24.4°
" 3 " ..	6	33	"	12	1:00 p. m.	"	18	5:45 p. m.	6	4¾	26.25°
" 1 Gen. 1	7b	60	July	6	1:15 p. m.	July	11	7:00 p. m.	5	5¾	32.40°
" 1 "	8c	58	"	8	3:00 p. m.	"	13	5:00 p. m.	5	2	37.67°
" 1 "	9d	43	"	8	4:30 p. m.	"	13	1:00 p. m.	4	21½	37.81°
" 1 "	10e	56	"	10	1:00 p. m.	"	14	9:00 p. m.	4	8	40.22°
" 3 Hib. adults ..	11	40	"	10	1:45 p. m.	"	15	11:30. a. m.	4	21¾	39.54°
" 1 Gen. 1	12f	32	"	11	4:00 p. m.	"	16	9:00 p. m.	5	5	38.46°
" 3 Hib. adults ..	13	28	"	14	2:30 p. m.	"	19	7:00 p. m.	5	4½	37.74°
" 1 Gen. 1	14	80	"	14	2:30 p. m.	"	19	6:00 a. m.	4	15½	35.64°
" 1 "	15	83	"	18	3:15 p. m.	"	24	8:00 a. m.	5	16¾	33.07°
" 3 Hib. adults ..	16	11	"	19	3:30 p. m.	"	25	6:00 a. m.	5	14½	34.05°
" 1 Gen. 1	17	53	"	19	12:30 p. m.	"	24	5:00 p. m.	5	4½	33.41°
" 3 Hib. adults ..	18	51	"	23	11:30 a. m.	"	27	12:00 m.	4	12½	38.43°
" 2 " ..	19	38	Aug.	4	10:00 a. m.	Aug.	9	9:00 a. m.	4	21	34.78°
" 2 " ..	20	26	"	5	10:30 a. m.	"	10	2:00 p. m.	5	3½	33.24°
" 3 " ..	21	41	"	5	10:30 a. m.	"	10	3:00 p. m.	5	4½	33.50°

But first attention should be drawn to the fact that there exists variation in the duration of embryonic development for batches of eggs deposited at the same time, hence subject to the same environmental factors including temperatures. Thus in lots 13 and 14 (Table I), from different parents, deposited at the same time on June 14 hatched at different times on June 19, lot 14 hatching 13 hours earlier than lot 13. And in lots 8 and 9; although there is a difference of an hour and a half between the times of deposition, the times of hatching diverge still more being separated by four hours and the lot deposited last hatched first. These lots were from the same parent. But contrary to this, in lots 10 and 11 deposited by different parents within 45 minutes of each other, the lot deposited first hatched first, the times of hatching being 14½ hours apart. However, lots 20 and 21 deposited by different parents at the same time hatched within an hour of each other. The data are insufficient but parentage apparently does not account for the variation between batches of eggs deposited simultaneously and we must state tentatively that it is inherent and hence subject to the laws of chance or else there are factors involved which have escaped detection. We think this variation is inherent and

hence limited or continuous and with sufficient data could be plotted in the same way as other continuous variations. It is of the same nature, apparently, as individual variations in the duration of postembryonic stadia, a matter of common observation and which are not controlled by temperature within certain time limits, nor by food.

As found previously, the daily average effective temperature increases as the period of embryonic development decreases and conversely. But for equal periods of development as shown in foregoing, equal amounts of temperature were not necessary, as witness lots 1 and 2, 7 and 12 and lots 13 and 21; also lots 9, 11 and 19. For a degree of temperature (effective) there appears to be a variable amount of growth or development, which as yet remains unpredictable; it is a specific, or maybe generic, characteristic.

2. *Number of Eggs Deposited.*

The data obtained on this point but serve to confirm what is stated by Girault (1908, p. 157 ff.) in a previous paper and also to increase the maximum number observed to be deposited by several hundred. The data were derived mainly by keeping in confinement three pairs of hibernated beetles captured early in the season while mating in a potato field and one or two pairs of the succeeding generations. The total number of eggs deposited, the rate of deposition and other related points for the pairs of the several generations are brought out in Table II presented herewith. The records fall short of what actually would have been the totals for the generations, as toward the second week in August the adult beetles were much neglected and finally died of starvation. The effect of this lack of nourishment on the second generation (or parents of the third generation) was especially noticeable, for although mating occurred freely throughout the different lots, oviposition occurred but once and most of the beetles disappeared into the soil for hibernation nearly as soon as their food was discontinued. The results indicate, however, that the first generation of adults are capable of as large an amount of reproduction as are the hibernated beetles and that the second generation of adults (or parents of the third generation) were willing or able to reproduce.

The three pairs of the hibernated beetles were obtained from a potato field in Urbana captured while mating at 11

ι. M., May 23 (pairs No. 1 and 2) and at 7:30 P. M., May ?7, 1908 (pair No. 3) and confined with food immediately ιfter capture. The single pair of the first generation resulted rom a mass of 60 eggs deposited by hibernated beetles and ;aken from the field on May 23, 1908 and the single reprolucing pair of the second generation are direct descendants)f the pair of the first generation.

In the case of an extra cage containing a large number of ιdults collected in the field during the latter part of July, a 'emale was observed to deposit a mass of 103 eggs, the largest ;ingle mass of eggs yet recorded. In another case, the rate of)viposition was timed; a female deposited in succession in a ;ingle mass in the usual manner 64 eggs in a period of time)ccupying 3200 seconds or 53 1-3 minutes. The rate of deposi-;ion was regular, each single deposit requiring 50 seconds—40 ;econds to pass the egg and to fasten it and about 10 seconds to)btain position for the next deposit.

Attention is called to the rapid deposition of the single)air of the first generation, having a daily rate of deposition)f 52 eggs and on a single day (July 8) depositing as many ιs 153 eggs in three separate batches, averaging 51 eggs each.

THE LARVA.

l. *Duration of Larval Stadia.*

We were able to make more observations concerning this)hase of the beetle's life during 1908 than at previous times. The records for the first fifteen lots in the annexed table (Table [II) comprise single larvae of the same age and parentage, that ;s, they are all from the same batch of eggs, hatching at the ;ame average time but confined separately each individual ;cdysis being recorded.

Lot No. 16, comprising 45 larvae, was from the same mass of 30 eggs as the larvae of lots No. 1-15, but upon hatching were :onfined together on their food. With them, the first ecdysis)ecame general at 4 P. M., May 29; the second ecdysis began ıt 7 P. M., May 31, but was not general until 2:30 P. M., June 1, and was completed at 6 P. M., June 1, occupying ι period of 23 hours. On June 3, the larvae were large, plump and healthy, eating voraciously, but only 30 in number, 15 having died. The third ecdysis began at 5 P. M., June 4,

TABLE III.

Duration of Larval Stadia for Different Generations, 1908.

Lot. No.	No. Larvae	Hatched	Source	1st Ecdysis Stadium I	Duration of Stadium Days	Duration of Stadium Hours	2d Ecdysis Stadium II	Duration of Stadium Days	Duration of Stadium Hours	3d Ecdysis Stadium III	Duration of Stadium Days	Duration of Stadium Hours	Entered soil Stadium IV	Duration of Stadium Days	Duration of Stadium Hours	Sums Days	Sums Hours	Total effective Temp. Degrees Fahr.	Average daily Effective temp. Degrees Fahr.
1	1	May 27, 11:00 a. m.	Hib. adults (nature)	May 29, 12:00 M.	2	1	May 31, 6:00 p. m.	2	6	June 4, 9:30 a. m.	3	15½	June 7, 4:30 a. m.	2	19	10	17½	285.8°	26.80°
2	1	"		" 29, 11:30 a. m.	2	½	" 31, 4:30 p. m.	2	5	Died									
3	1	"		" 29, 12:30 p. m.	2	1½	" 31, 11:00 p. m.	2	10½	Died 10 a.m. June 2	..	..	......	..	..	..	..	......	......
4	1	"		" 29, 7:00 a. m.	1	20	" 31, 2:00 p. m.	2	7	"			......	..	..	..	..	......	......
5	1	"		" 29, 7:00 a. m.	1	20	" 31, 1:30 p. m.	2	6½	June 4, 9:30 a. m.	3	19	Died	..	..	..	..	......	......
6	1	"		" 29, 11:00 a. m.	2	..	" 31, 7:00 p. m.	2	8	" 4, 12:00 M.	3	17	June 8, 7:00 p. m.	3	19	11	20	345.9°	28.05°
7	1	"		" 29, 8:00 a. m.	1	21	" 31, 1:30 p. m.	2	5½	" 4, 9:30 a. m.	3	19	" 7, 4:30 a. m.	2	19	10	17½	285.8°	26.80°
8	1	"		" 29, 1:00 p. m.	2	2	" 31, 6:00 p. m.	2	5	" 4, 11:00 a. m.	3	17	" 7, 4:30 a. m.	2	17½	10	17½	285.8°	26.80°
9	1	"		" 29, 11:00 a. m.	2	..	" 31, 11:00 p. m.	2	12	Died June 6									
10	1	"		" 29, 8:00 a. m.	1	21	" 31, 11:30 a. m.	2	3½	June 4, 6:00 a. m.	3	16½	Died	..	..	..	..	......	......
11	1	"		" 29, 2:00 p. m.	2	3	June 1, 9:00 a. m.	2	19	" 4, 12:00 M.	3	3	June 8, 7:00 p. m.	3	19	11	20	345.9°	28.05°
12	1	"		" 29, 10:00 a. m.	1	23	May 31, 2:30 p. m.	2	4½	" 4, 7:00 a. m.	3	16½	" 7, 4:30 a. m.	2	21	10	17½	285.8°	26.80°
13	1	"		" 29, 1:00 p. m.	2	2	June 1, 2:00 p. m.	3	1	Died 6 p. m., June 3	..		......	..	..	..	..	......	......
14	1	"		" 29, 3:00 p. m.	2	5	" 1, 1:00 p. m.	2	22	June 5, 11:00 a. m.	3	22	Died	..	..	..	..	......	......
15	1	"		" 29, 12:30 p. m.	2	1½	" 1, 7:00 a. m.	2	16½	" 4, 6:00 p. m.	3	11	Died	..	..	..	..	......	......
..	..	1–15 Average			2	½		2	14½		3	12½		3	6¼	11	9½		......
16	45	May 27, 11:00 a. m.		May 29, 4:00 p. m.	2	5	June 1, 2:30 p. m.	2	22½	June 5, 8:00 a. m.	3	17½	June 7, Noon	2	4	11	1	298.2°	27.10°
17a	..	July 7, 6:30 a. m.		July 10, 2:00 p. m.	3	7½	July 13, 6:00 a. m.	2	16	July 15, 12:30 p. m.	2	6½	July 19, 7:00 a. m.	3	18½	12	½	425.5°	35.45°
18b	..	" 11, 7:00 p. m.	Gen. I—mixed	" 14, 6:00 a. m.	2	11	" 16, 1:00 p. m.	2	7	" 19, 7:00 p. m.	3	6	" 24, 8:00 a. m.	4	13	12	13	453.56°	35.82°
19c	58	" 13, 5:00 p. m.	Gen. I—Pair No 1	" 15, 6:00 p. m.	2	1	" 18, 11:00 a. m.	2	17	" 22, —:— p. m.	..		" 25, 9:00 p. m.	..		12	4	433.13°	35.12°
20d	43	" 13, 1:00 p. m.		" 16, 6:00 p. m.	3	5	" 18, 12:00 M.	2	6	" 20, 9:00 p. m.	2	9	" 24, 8:00 p. m.	4	1½	11	21½	409.26°	35.09°
21e	56	" 14, 9:00 p. m.		" 17, 12:00 M.	2	15	" 19, 1:00 p. m.	2	1	" 22, —:— p. m.	..	..	" 25, 11:00 p. m.	..	..	11	2	385.40°	35.03°
22f	32	" 16, 9:00 p. m.		" 18, 6:00 p. m.	2	21	" 21, 9:00 p. m.	3	3	" 23, —:— p. m.	..	..	" 27, 6.00 a. m.	..	..	10	9	362.00°	35.04°
		a to f Average			2	16¾		2	14		2	18¼		3	3¾	11	11		

and was general at 8 A. M., June 5, concluding at 2 P. M., June 5, occupying a period of 21 hours. But 18 larvae successfully survived the ecdysis. Entering the soil for pupation began on June 7, at 4:30 A. M. and all larvae had entered by June 8, 7 P. M. Table III summarizes.

2. *Number of Ecdyses.*

There can be no doubt but that the normal number of larval ecdyses, excluding pupation, is three and as additional evidence we have observed this number in two hundred and the fifty cases during the season without a single exception for whole number. The question may be considered as settled.

3. *Duration of the Larval Stage.*

There being no data concerning this point other than what are already included in Table III, it is unnecessary to repeat them here, but reference should be made to the column of sums of that table.

THE PUPA.

1. *Duration of Pupal Stage.*

Table IV summarizes sufficiently well all of our data for 1908 concerning this phase of the beetle's life cycle.

TABLE IV.

DURATION OF PUPAL STAGE, ACTUAL TIME IN SOIL, SEASON 1908.

Lot No.	No. Pupae	Entered Soil.	Adults Emerged	Length Time in Soil.		Sum of Effective Temp. Degrees Fahr.
				Days.	Hours.	
1	1	June 7, 4:30 a. m.	June 21 1:30 p. m.	14	9	418.4°
6	1	" 8, 7:00 p. m.	" 22, 6:00 a. m.	13	11	383.2°
7	1	" 7, 4:30 a. m.	" 19, 4:00 p. m.	12	11½	307.5°
8	1	" 7 4:30 a. m.	" 21, 1:30 p. m.	14	9	418.4°
11	1	" 8, 7:00 p. m.	" 22, 1:00 p. m.	13	18	396.6°
12†	1	" 7, 4:30 a. m.	" 21, 1:30 p. m.	14	9	418.4°
16	45	" 7, noon	" 22, noon	15		444.2°
17a	..	July 19, 7:00 a. m.	July 30, 6:00 p. m.	11	9	425.9°
18b	..	" 24, 8:00 a. m.	Aug. 4, 7:00 p. m.	11	11	450.6°
19c	58	" 25, 9:00 p. m.	" 6, 7:00 a. m.	11	10	404.5°
20d	43	" 24, 11:00 p. m.	" 4, 8:30 a. m.	10	9½	396.4°
21e	56	" 25, 11:00 p. m.	" 5, 12:15 p. m.	10	13¼	397.4°
22f	32	" 27, 6:00 a. m.	" 6, 6:00 p. m.	10	12	410.6°

* These numbers correspond with the lots in Table III.

† Average of Lots No. 1 to 12, 13 days, 19½ hours.

THE ADULT.

1. *Length of Life in Confinement.*

a. In Pairs Normally Reproducing.

The data obtained on this point are scanty and much vitiated by the fact that the lots were neglected too soon to obtain normal results, but they supplement to some extent the data obtained in 1907 tending to support the theory that the average duration of life of normally reproducing adults is two months or more. The average here is 1.8+ months, the data however being insufficient.

TABLE V.

LENGTH OF ADULT LIFE IN CONFINEMENT, NORMALLY REPRODUCING.

Lot No.	No. Individuals.		Source.	Date Confined, 1908 (Emergence.)	Date of Death, 1908.		Length of Life Months	
	Male	Female			Male	Female	Male	Female
I. Hibernated								
1	1	1	....	11 a. m., May 23	June 4*	July 7	0.4	1.5
2	1	1	Potato field, mating.	11 a. m., May 23	Aug. 16†	Aug. 16†	2.8+	2.8+
3	1	1		7:30 p.m., May 27	July 26	Aug. 16†	1.96	2.66
II. Gen. I								
1	1	1	Hibernated adults (nature)	June 23	Aug. 16‡	Aug. 16‡	1.8+	1.8+
III. Gen. II	Many	Many	Pair No. 1, Gen I.	July 30—Aug. 8	August‡	August‡	0.5+	0.5+

* Escaped. † Liberated. ‡ Starved and entered hibernation.

2. *Length of the Period of Oviposition.*

As with the previous section, the results here are abnormally short in point of duration for the reasons given. They are merely tabulated therefore, without further comment.

TABLE VI.

LENGTH OF THE PERIOD OF OVIPOSITION. DIFFERENT GENERATIONS, 1908.

Generation No.	First Mated.	First Eggs Deposited.	Last Eggs Deposited.	Length of Period of Oviposition, Days.
Hibernated—				
Pair No. 1..........	11 a. m., May 23	7 p. m., May 23	2:50 p.m., July 4	42+
Pair No. 2..........	11 a. m., May 23	May 25*	August 16, p. m.	83
Pair No. 3..........	7:30 p.m., May 27	1:30 p. m., May 28	August 12, p. m.	76
I—Pair No. 1..........	9 a. m., June 23	July 8, a. m.	10 a. m., July 27	20+
II.—Pair No. 1c........	Aug. 11, 3 p. m.	Aug. 11, 10 a. m.	Aug. 12, p. m.	1+

* Average time of a period of 4 days.

3. *Mating.*

The observations on this habit are also limited, but those matings actually observed are summarized in Table VII. In a single case, the time actually involved from beginning to end of the act was obtained, being three and one-half hours (10:30 A. M. to 2 P. M., June 18, Pair No. 3, hibernated adults.)

TABLE VII.

FREQUENCY OF MATING IN REPRODUCING PAIRS. DIFFERENT GENERATIONS, 1908.

ation No.	Pair No.	First Mating	Subsequent Matings	Last Matings	No. of Matings	Observed Period of Mating, Days	Period of Oviposition, Days	No. Eggs. Masses Deposited
ernated	1	11 a. m., May 23	May 28, 30, 31 June 1	June 4*	6	12	42	25
	2	11 a. m., May 23	May 27, 30 June 2, 4, 21 July 1, 23, 26, 28 Aug. 3, 4, 5, 5, 7, 7	August 11	17	80	83	48
	3	7:30 p. m., May 27	May 30 June 3, 4, 10, 13, 18, 18, 20, 24, 24 July 1, 9, 15, 17, 17	July 18	17‡	52	76	50
I	1	9 a. m., June 23	....	July 8	2	15	20 –	22
II	1a 1c 1d 2d 3d	Aug. 3, 3 p. m. Aug. 9, 4 p. m. Aug. 9, 10 a. m.° Aug. 9, 10 a. m.° Aug. 9, 6:30 a. m.°	Aug. 4, 5, 6 Aug. 11, 12	Aug. 7, 9 a. m.‡ Aug. 13, 3 p. m.	5 4	3½ 4	1 –	2
	1e 1f	Aug. 11° Aug. 11	Aug. 13	Aug. 14	3	3	..	

* Male escaped. † Male died July 26. ‡ Male entered soil for hibernation.

° Only observed mating; hibernation followed within 10 days.

Mating was observed during the following hours of the day: Practically at any hour between 7 A. M. and 11 P. M., more commonly at 9, 10 and 11 A. M. and 1, 2, 3, 4 and 6 P. M. or at fractions of those hours. The function was observed most commonly at 9 and 10 A. M., over 31 per cent of the 58 times the act was observed being either at or between those two hours. Fifty per cent of the observed matings occurred in the morning and fifty per cent. in the afternoon or evening. Observations were continued throughout most of the night, up at least until midnight, commencing again at six o'clock in the morning.

4. *Potency of Fertilization.*

As concerns this point, it was noticed in the case of the hibernated pairs, and with these pairs only was opportunity presented to gather any data bearing on the question, that the female of Pair No. 1 continued to deposit fertile ova for one month after the absence of the male (June 4, 7 P. M., to July 4, 2:50 P. M.); and that the female of Pair No. 3 deposited fertile ova for seventeen days after the death of her mate. No other data were obtained.

5. *Number and History of Generations Reared in the Laboratory.*

Our data here are also meagre, but they certainly do tend to uphold the opinion that the adults of the second generation (or parents of the third generation) are at least able, if not willing, to reproduce and hence the observations of last year (Girault 1908) are upheld and Tower's (1906) dictum that "The second generation does not develop the germ-cells nor show any reproductive activity until after it has passed through a period of hibernation or aestivation" becomes in our minds less and less authoritative. These beetles of the second generation with us certainly showed reproductive activity, if repeated matings can be called such, and one pair, even under very adverse conditions—starvation—deposited fertile eggs, which surely must be conceded to be reproduction which cannot of course take place without development of the germ-cells. The beetles with us this year plainly showed symptoms of what we would call eagerness and ability to reproduce. These beetles were those of the second generation, as will be shown in the following brief historical sketch, and were normal in every way, that is to say, did not represent any special race of the species.

On May 23, 1908, or at the earliest possible date, 60 eggs of the species were collected from a potato plant in a small plot of potatoes at Urbana, Illinois and brought to the laboratory to comprise the first generation or descendants of the hibernated adults. The larvae came to maturity early in June and pupated and eleven adults emerged between June 21 and June 23. They were confined together with food. On the latter date a pair were found mating and were at once isolated as the parents of the second generation.* From this pair of adults of the first generation, there were taken for the special

* The others were accidentally poisoned with arsenate of lead.

pose of rearing a sufficient quantity of the second generation, lots or batches of eggs numbered from *a* to *f*. In all 49 adults e obtained from the six batches. For clearness, the batches treated in detail: (1) Batch *a*, consisting of about 20 mber unknown) eggs hatched at 6:30 A. M., July 7, the ulting larvae entering the soil for pupation at the average e of 7 A. M., July 19 and on July 30 and 31, 4 adults e obtained. These were at once fed and at 3 P. M., August a pair were observed mating and were isolated. This pair tinued to mate until 9 A. M., August 7, the ♂ entering the il shortly afterward; with them mating was observed five nes, but no oviposition occurred. In the meantime, the o remaining beetles had hibernated (August 8), the mated male following a week later. Hibernation induced by starvation due to lack of time in which to feed the beetles. (2) atch *b*, consisting of 60 eggs came to larval maturity at 8 A. M., ly 24, and on August 4 and 5, two adults were obtained mprising the whole survival. These were males and hiberated on August 22. (3) Batch *c*, 58 eggs, came to larval aturity at 9 P. M., July 25, and gave from August 5 to 4 adults which were placed on food as they emerged. A ale died on August 8 and a pair were mating at 4 P. M., ugust 9; this pair was then isolated. On August 11 at) A. M., 3 eggs were deposited which proved to be fertile; ating was again observed at 3 P. M. the same day and at the me hour on August 12; later the same day (12) 9 eggs ere deposited on a leaf, which also proved to be fertile; another ating was observed at 9 A. M., August 13, but thereafter no ther matings were observed and further reproduction did not ccur. The remaining adult died on August 22, but the ated pair remained alive without food until August 25, hen the cage was broken up. Oviposition and mating in pite of insufficient food. (4) Batch *d*, 43 eggs, came to larval aturity at 10 P. M., July 24, and on August 4 from 7 to 9 A. M., 11 adults were obtained, the total survival. On ugust 9, 3 pairs observed mating were isolated but other atings did not occur with them nor oviposition, caused as we ave reason to believe, by the neglect to supply food. Thus, n August 13 the third pair had entered the soil for hibernation nd two days later the second pair had done likewise; e first pair remained on top of the soil until August 25,

when they were killed and removed. Of the remaining five adults, two had died by August 11 and the three others hibernated on August 22. (5) Batch *e*, 56 eggs, came to larval maturity at the average time of 11 P. M., July 25, and gave 24 adults from August 4 to August 6, which were confined together with food. But a single pair was isolated, observed mating on August 11, though previously, mating had occurred promiscuously. This pair was neglected after isolation and no further reproductive activity occurred; on August 13 at 9 A. M., the male entered the soil for hibernation and on August 25 the pair were removed still alive. Of the remaining 22 beetles, 4 hibernated on August 11 at 9 A. M. and by August 22, all had disappeared beneath the soil, two having died there. No reproduction, but during the period of feeding, after several days, mating was frequent and promiscuous and there is good reason for believing that reproduction was prevented by actual starvation at a critical period. (6) Batch *f*, 32 eggs, arrived at larval maturity at the average time of 6 A. M., July 27, and gave 4 adults August 7 and 8; on August 11, a mating pair of this lot were isolated and the remaining two also paired. The first pair mated again on August 13 and August 14 but no oviposition followed and they were removed on August 25, after days of starvation. The second pair had hibernated by August 22, without depositing eggs and with no further observed matings.

In general it may be stated that the adults of the second generation just after emergence fed voraciously for several days and then began to mate as though eager to reproduce and one pair acutally deposited fertile eggs, insuring at least a portion of a third generation. It was at this time in their lives, just following the period of heavy feeding and the beginning of mating that stress of other work caused the food to be neglected and after August 8, the beetles were starving and were forced to hibernate. Incidentally, it was also true that their food-plant in nature was also very scarce at this time, so even if at large, it is not unreasonable to suppose that these beetles of the second generation would have been forced into hibernation before reproduction could begin, though willing and able to reproduce. What little evidence we have gathered this year forces us to conclude that the second generation of adults *exceptionally* are both willing and able to reproduce, merely

upplementing what was previously indicated to be true in 1907. The evidence of course is gross in nature, for we did not actually examine the mated females in any case for spermatozoa, so that in the majority of cases, actual mating is open to question. It is needless to say that this should have been done. But in at least one case we are sure that both mating and reproduction occurred as fertile ova were deposited.

In regard to the seasonal history in 1908, the second generation was obtained nearly a month earlier than that obtained in 1907, so that there was ample time for a third generation. The following table summarizes the generations reared in confinement.

TABLE VIII.

GENERATIONS REARED IN THE LABORATORY, URBANA, ILLINOIS, 1908.

Generation No.	Eggs Deposited.	Adults Out.	Length of Cycle.		Effective Temp Sums, Degrees F.
			Days	Hours	
I.	May 21*	June 22	32	..	948.2°*
II. Lot a	July 2†	July 30, 11 p. m.	28	12	..
b.	July 6, 1:15 p. m.	August 4, 7 p. m.	29	5¾	1062.3°
c.	July 8, 3 p. m.	August 6, 7 a. m.	28	16	1056.6°
d.	July 8, 4:30 p. m.	August 4, 8:30 a. m.	26	16	979.6°
e.	July 10, 1 p. m.	August 5, noon.	25	23	976.9°
f.	July 11, 4 p. m.	August 7, 6 p. m.	27	2	1009.9°
III.	August 11 and 12.	Not reared to maturity	..	..	..

* Approximated; hatched 11 a. m., May 27. † Approximated; hatched 6:30 a. m., July 7.

LITERATURE REFERRED TO.

1905. **Stiles, Charles Wardell,** Bull. No. 24, Hygienic Laboratory, Public Health and Marine-Hospital Service of the United States, Treasury Department, Washington, D. C.

1906. **Tower, William Lawrence.** An investigation of evolution in chrysomelid beetles of the genus Leptinotarsa. Publication No. 48, Carnegie Institution of Washington, Washington, D. C.

1907. **Girault, Alexandre Arsene and Arthur H. Rosenfeld.** Biological notes on the colorado potato beetle, Leptinotarsa decemlineata (Say), with technical description of its stages. Psyche, Cambridge, Mass., XIV, pp. 45-57.

1908. **Girault, Alexandre Arsene.** Further biological notes on the colorado potato beetle, Leptinotarsa decemlineata (Say), including observations on the number of generations and length of the period of oviposition. Annals Ent. Society of America, Columbus, Ohio, I, pp. 155–178.

MINUTES OF THE MINNEAPOLIS MEETING.

The Fifth Annual Meeting of the Entomological Soci[illegible] of America was called to order at 10:45 A. M., December [illegible] 1910, in the School of Mines Building, University of Minnes[illegible] Minneapolis, by the President, Dr. John B. Smith. In [illegible] absence of the Secretary, Professor J. G. Sanders was elec[illegible] Secretary pro tem. Announcements.

Professor F. L. Washburn moved that the chair appoin[illegible] committee of three to confer with a similar committee from [illegible] Association of Economic Entomologists concerning the orga[illegible]ation of an Entomological Employment Bureau or Clear[illegible] House. It was agreed that the organization of such a b[illegible] would facilitate the securing of available men for entomolog[illegible] work. Several expressed favorable opinions concerning [illegible] proposition.

The following papers were presented:

Notes on the Tingid *Leptobyrsa explanata* Heid., by E. [illegible] Dickerson; read by the Secretary.

Notes on *Sanninoidea exitiosa* by Dr. J. B. Smith. Discu[illegible]sion by Mr. R. L. Webster, asking if any tables of head wid[illegible] of various larval instars of this species had been published. H[illegible] reported that such measurements constituted a very [illegible] method of identification.

"The Structure of Spermatophores in Crickets," by M[illegible] J. P. Jensen. Read by the author. (Published in Mar[illegible] ANNALS.)

Dr. Smith asked if studies had been made of the copula[illegible] organs in various species. Mr. Jensen replied that comparati[illegible] drawings of a large number of individuals of the same spec[illegible] had been made, likewise of different species. He also reporte[illegible] that *Nemobius fasciatus* var. *vittatus* had been found in lar[illegible] numbers digging in loose soils, securing and destroying eggs [illegible] *Melanoplus bilineatus*. He considered this insect as undoubte[illegible]ly a considerable factor in the control of *Melanoplus*. D[illegible] Smith questioned: "Is not such the general habit of [illegible] *Orthoptera*?" Was answered by Professor Bruner. "Ma[illegible] *Orthoptera* are largely carnivorous."

Professor Oestlund invited members to visit and insp[illegible] his collection of *Aphididae*.

The Society then adjourned until 1:30 P. M.

The President appointed the following committees when the Society reconvened:

Committee on Employment Bureau to confer with similar Committee from the Association of Economic Entomologists: Messrs. F. L. Washburn, Herbert Osborn, and Henry Skinner.

Nominating Committee: Professors E. D. Sanderson, H. E. Summers and R. L. Webster.

Auditing Committee: Professors Lawrence Bruner and J. G. Sanders.

The following papers were read:

"The Biological Survey of the Insect Life of Kansas" by Professor S. J. Hunter.

"An Experimental Study of the Death-Feigning Habit of *Belostoma (Zaitha) flumineum* and *Nepa apiculata* Uhler," by H. C. and H. H. Severin. Discussed by E. C. Cotton with the remark that the weevil *Apion segnipes* which worked in border pea-pods in Tennsesee was unable to free itself from the pod but is released automatically by the sudden opening of the pod. The *Apion* when disturbed under such conditions does not feign death, but if handled later it feigns death.

"Announcement of Further Results Secured in the Study of *Tachinidae* and *Allies*," by C. H. T. Townsend, Piura, Peru. This paper was read in part by the Secretary. (To be published in June ANNALS.)

The "Report of the Committee on Nomenclature" was written by Professor T. D. A. Cockerell with H. T. Fernald and E. P. Felt and was read by the Secretary. After some discussion, Prof. H. E. Summers moved to receive the report, order it printed and consider it at a later date. Carried.

The Society then adjourned until Wednesday at 9:00 A. M.

At 9:00 A. M., December 28, the Society was again called to order by the President, Dr. Smith, and the following reports presented:

The Report of the Editor of the ANNALS, Professor Herbert Osborn, was presented and on motion of Professor Lawrence Bruner, was accepted.

The Report of the Auditing Committee on the accounts of the Editor was presented by Professor Lawrence Bruner and accepted. He also reported on the accounts of the Treasurer for the Committee and they were accepted subject to correction.

The Report of the Secretary of the Executive Committee was presented and accepted and is given in full later.

The following paper was read:

"Some Suggested Rules to Govern Entomological Publications," by T. D. A. Cockerell, read by the Secretary. Several suggestions were made by Dr. Wolcott concerning entomological publications, as follows:

That it is the privilege of contributors to demand proof of their papers, but it is also obligatory that corrected proof be returned as soon as possible. Likewise, it was remarked that contributors could not expect manuscripts to appear in print on extremely short notice, as is frequently the case, but should expect their papers to take their turn.

The Nominating Committee reported as follows for officers for 1911:

President—PROFESSOR HERBERT OSBORN.

First Vice President—PROFESSOR LAWRENCE BRUNER.

Second Vice President—PROFESSOR A. D. MACGILLIVRAY.

Secretary-Treasurer—PROFESSOR A. D. MACGILLIVRAY.

Additional Members of the Executive Committee:

Professor J. H. COMSTOCK	DR. W. M. WHEELER
DR. J. B. SMITH,	DR. H. SKINNER,
PROFESSOR C. J. S. BETHUNE,	DR. A. D. HOPKINS.

It was moved by Professor M. H. Swenk that the Secretary be instructed to cast a unanimous ballot for the officers nominated.

Professor E. D. Sanderson moved that a vote of thanks from the Society be extended to Professor Herbert Osborn, Managing Editor, for his faithfulness and especial care in the publication of the ANNALS.

Professor T. B. Symons moved that a vote of thanks be extended to the authorities of the University of Minnesota for their kindness in offering the use of the School of Mines Building for the Meetings of the Society.

On motion of Professor T. B. Symons, the Society adjourned to meet in joint session with the Association of Economic Entomologists in the afternoon.

The Annual Public Address was given in the Handicraft Guild Hall at 8:00 P. M., by Professor F. L. Washburn: The Typhoid Fly in the Minnesota Iron Range.

Report of the Executive Committee.

December 27, 1910.

The Executive Committee met in the corridor of the Hotel Dyckman at 10:00, with the following members present: Professors Smith, Bruner, Osborn, and Sanders. The following business was transacted:

List of Members Deceased during the Year Ending November 30, 1910.

F. A. Herrick, New Brighton, Pa.
G. W. Peck, Roselle Park, N. J.
Henry Ulke, Washington, D. C.
G. A. West, Urbana, Ill.
Rev. J. L. Zabriskie, Brooklyn, N. Y.

The following were elected to membership in June, 1910:

E. M. Walker,
Edward E. Philips,
Alvin R. Cahn,
C. R. Alexander,
Miss A. C. Stryke.

The following were elected by the Executive Committee:

Henry E. Ewing,
M. D. Leonard,
R. D. Whitmarsh,
E. W. Stafford,
E. O. Essig,
H. R. Jennings,
George G. Becker,
Miss E. I. McDaniel,
F. H. Shoemaker,
W. R. McConnell,
W. R. Thompson,
D. Finkelstein,
C. R. Plunkett,
E. W. Scott.

The following resignations have been accepted and membership terminated:

C. C. Adams,
J. S. Faaborg,
A Mares.
F. W. Powers,
W. G. Wright.

The Secretary-Treasurer reported a list of eighty members, who, according to the rules of the Society, had been dropped for the nonpayment of dues. The Executive Committee referred this matter back to the Secretary and authorized him to write a personal letter to each.

The Treasurer presented the following report of receipts and disbursements for the year ending November 20, 1910.

RECEIPTS:		
Balance forward		$ 38.32
Received from H. Osborn, subscriptions		109.05
Cash received for dues, 1910	316.70	
Cash received for dues past	80.00	396.70
Cash received for subscritpions, 1910	$243.00	
Cash received for subscriptions, past	58.90	
		$301.90
H. Osborn, Nov. 11, 1910		135.07
Total		$981.04
DISBURSEMENTS:		
For ANNALS, Dec., 1909, 1000	$182.70	
March, 1910, 800	192.68	
June, 1910, 800	170.23	
		$545.62
Includes reprints, etc., clerical, typewriting		37.40
Postage, stamped envelopes, cards		22.21
Half-tones ANNALS		9.22
Dues, notices, statements		11.50
Express, telegrams, ledger paper, dating stamp		1.60
Excess remittance returned to Akerlind		1.00
Balance cash on hand		352.49
Total		$981.04

Of the $352.49 now on hand $100, the fees from life members, is deposited in the Rothschild Bank of Ithaca where it is drawing 4% interest.

There is charged against the Society to offset dues of members dropped, resigned and deceased, 91 members, $239.85; Charges against ANNALS to offset subscriptions for members dropped, resigned and deceased, $35.00; total, $274.85.

These charges reduce the apparent assets for the year considerably. Quite a number of these members dropped out last year, but the proper charge was not made on the books.

The Secretary was instrncted at the Boston Meeting to take a mail vote of all members and fellows of the society as to whether the present arrangement for separate dues and subscriptions to the ANNALS should remain in force, or whether they should be combined into a single fee of two dollars with the provisions that all should receive without further expense the publications of the Society. The result of this vote was as follows: For the amendment 182; against the amendment 18; blanks returned but preference not expressed 2; total 202. While the vote was decidedly in the affirmative, only slightly over one-half of the members voted.

J. G. SANDERS, *Secretary.*

Report of the Committee on Nomenclature.

The Committee has received a letter from Dr. C. W. Stiles, of the International Commission on Zoological Nomenclature, stating that it is proposed to work out the correct names of all the animals most intimately connected with man. In the course of this work, it becomes necessary to deal with the insect parasites of man, and it is desired that the list, as finally presented, shall show the correct names as determined under the International Code, and enumerate all the synonyms. Dr. Stiles suggests that this work on the insects shall be undertaken in the first instance by the Nomenclature Committee of the Entomological Society of America, in correspondence with the like Committee of the Association of Economic Entomologists, and such other persons as it may seem desirable to consult. The report so prepared should, it is suggested, be referred to the Committee on Nomenclature of the International Entomological Congress and the International Commission on Zoological Nomenclature, whence it would pass to the Zoological Congress three years hence.

Your Committee is anxious to further these plans, recognizing that the proposed list would be of great service. There are, however, some difficulties. The Committee of the Association of Economic Entomologists was formed for the purpose of determining the common or vernacular names of insects, and has not hitherto concerned itself with scientific nomenclature beyond printing lists of scientific names to accompany and define the common names proposed. Your Committee itself was appointed to discuss nomenclatural questions, for which the data were supposed to be provided, and did not expect to have to report on matters outside of the range of nomenclature. It is obvious that the preparation of a complete and authentic list of the insect parasites of man involves many taxonomic questions to which nomenclature is only secondary. It is not understood whether the list should include only parasites in the restricted sense, but we suppose that in order to be of real value and importance, it should contain the names of various blood-sucking forms, Culicidae, *Glossina*, etc., etc., which are certainly intimately connected with man. Taking this for granted, we are at once brought into contact with various difficulties, e. g.,

those connected with the proper classification of the Culicidae, and under the circumstances, your committee is wholly unwilling to merely compile a catalogue from the literature, correcting any obvious violations of the rules of nomenclature which may be found.

Probably the only way in which your Committee could prepare a satisfactory work would be through inviting specialists in the different groups of insects to submit their lists, which might be published under the signatures of their authors, and discussed and amended as might seem necessary. For this purpose mere outlines, without details, would usually suffice. If the cooperation of the specialists was freely given, and their proposals were freely discussed for a period, the Committee might then be in a position to bring the results together in a single catalogue.

The Committee would call the attention of entomologists generally, to the importance of preparing lists giving the synonymy and indicating the generic types in their respective groups. Such work would go far toward permanence in generic designation, particularly if of such a scope as to include the genera of an entire faunal region, rather than accepting a continental or national limitation. Such contributions to knowledge should involve assistance from practically all workers in a group and your committee hopes that shortly this will be the general rule.

In dealing with various matters, it is occasionally found that the International Code, as at present constituted, is either capable of more than one interpretation, or fails to settle a matter in dispute. We have discussed some of these questions, but at the present time desire only to offer the following suggestions for the consideration of the Society. It is to be understood that so far as these provisions may be different from or additional to those of the International Code, it is intended that, if they are adopted, they shall be transmitted to the International Committee, for consideration as amendments to the code.

(1) Secondary homonyms, based on invalid combinations, shall not be recognized. This means that if a new species is published as A—b—, and is later wrongly transferred to another genus as B— b—, it is still permissible for an author to describe a new species as B— b—, although he may not

name one A— b— even if the species originally so named has been properly transferred to some other genus.

This point is not specifically covered by the International Code, although the spirit of the code seems rather against it. It is however covered by the American Ornithologists' Union Code (1908 edition, p. lvii), and correspondence shows that it is favored by many entomologists.

(2) When an author describes a new species, citing several localities, and not mentioning any one as typical, then any writer following may designate any one of the localities originally given as the type locality, provided always that nothing in the original name or description indicates otherwise. (If the name of the species has reference to any locality or to any collector who collected in only one of the localities cited, this will suffice to fix the type locality from the original publication alone.)

The following, formulated by a member of the committee, is now offered for discussion without endorsement, the majority of the committee feeling that it requires further consideration or perhaps amendment.

(3) Generic names shall not be considered as validly published unless the author, at the time of publication, either mentions an included species by its scientific (binominal) name, which name has been validated by a description; or cites a species in such a way that definite reference can be made, following the data given, to a previously published scientific name. It may be held, however, that when a genus is proposed with a description, and a single new species cited as type, the latter without description, then the generic description may cover both, just as if the author had given the whole combination at the beginning, followed by "n. g. and sp.", as is frequently done.

Differences of opinion exist as to whether the above rule, or the spirit of it, is in accordance with Article 25 of the International Code.

H. T. Fernald,
E. P. Felt,
T. D. A. Cockerell.